THE ILLUMINATING ENGINEER

LIGHT LAMPS FITTINGS AND ILLUMINATION

THE JOURNAL OF GOOD LIGHTING

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Modern Domestic Lighting

ON pages 103 to 111 we present Mr. H. T. Young's paper on the above subject, read before the Illuminating Engineering Society on March 19th, and the ensuing discussion. Readers may judge for themselves the happy combination of practical and decorative conceptions of domestic lighting developed in Mr. Young's address. Only those who were present at the meeting, however, had the benefit of the interesting display of lighting methods staged by Mr. Young, which added greatly to the interest of the paper. This opportunity should not be lost of drawing attention to the very considerable amount of pains taken by Mr. Young and his assistants, in this and other ways, in order to make the meeting a success.

We do not think it can be doubted that the meeting *was* a success. The audience was a numerous one—we believe one of the largest drawn by any meeting of the Society—and to some members it was doubtless a new experience to meet in the fine lecture theatre of the Institution of Electrical engineers, the lighting of which in itself serves as a striking demonstration of modern methods.

For the rest there can surely be no question but that the paper fulfilled the desires of the author by stimulating discussion and revealing differences in points of view. Certain aspects of modern lighting with electricity were no doubt intentionally emphasized in order to draw discussion. Mr. Young would doubtless endorse the recognition of Mr. S. Chermayeff (himself a gifted exponent of decorative design), that two distinct aims in illumination—lighting for a definite purpose and lighting for effect—exist. These aims cannot always be reconciled, and it will always remain a question, depending on local circumstances, how far each aspect should predominate.

In the homes of middle-class people for a long time to come we venture to think that the sound practical aims outlined in the latter part of Mr. Young's paper will prevail. Comfort in lighting is too recent to be anything but a precious gift still. The average householder expects first that the lighting shall enable him to do with ease all he wants to do in his home. Only after this has been achieved will he and the lady of the house concern themselves with decorative effect.

It is chiefly in the houses of the wealthy and the comparatively well-to-do that the development of domestic lighting as an art or a plaything has the greatest possibilities. Why, indeed, should not lighting be treated in the same manner as carpets, wallpapers and furniture, and regarded as yet another outlet for creative design. Even assuming that this aspect of domestic lighting is accepted there remains scope for considerable latitude of treatment. It is unlikely that "period" decorative and lighting equipment will entirely disappear for some time to come. There is a certain school of thought which inclines naturally to the preservation of the restful atmosphere of the past, as a contrast with the movement and effort of the present day. This outlook usually carries with it a preference for subdued illumination. (The writer was once assured that a complaint that certain Queen Anne furniture could not be seen by the dim light evoked no response from the architect; the consumer was told that preservation of the correct period conditions demanded that it should *not* be seen!)

At the other end of the scale we have the craving for intensely novel and striking effects, such as have been shown in some of the ingeniously equipped rooms staged at the Ideal Home Exhibition during recent years. In some of these cases one could say definitely that the desire to create an arresting picture quite dominated the design; the rooms were good to look at but hardly such as most of us would wish to live in!

Many intermediate stages exist and in the modern home there will doubtless be plenty of opportunities for such devices as luminous panels and lintels, staircase corner-lights, cove-lighting, concealed alcove lighting, etc. Everyone, of course, is entitled to his or her individual preferences in such matters. For our part we confess an admiration for methods involving unobtrusive lighting, the lighting equipment becoming part of the scheme of decoration—so that the observer is first charmed by the general effect and only subsequently begins to speculate on the means. This, to our mind, is truly "architectural lighting." We confess we are less happy when the "works"—strange shapes in mottled glass and polished steel—are strikingly in evidence. Again, certain forms of table lamps seem to function less perfectly than the simple shades of the past—even if the contemplation of their ingenious design gives intellectual pleasure.

But here we have come to the limit of our space and find ourselves at the end enmeshed in argument—surely yet another tribute to the provocative charm of Mr. Young's paper.

Industrial Lighting

TIME is passing. This was brought home to us at a recent meeting in the lecture theatre of the Royal Society of Arts, when Mr. D. R. Wilson was the lecturer on industrial lighting, and Sir John H. Parsons was in the chair. These two names, and that of Dr. J. W. T. Walsh, who was also present, are linked with the production of the now famous report of the Home Office Departmental Committee on Lighting in Factories and Workshops, issued in 1915. Since that day almost a new generation has arisen. It is only the old hands who recall this report and its two successors —the whole forming a wonderful record of work in the industrial field.

Mr. Wilson's paper showed the author's characteristic tolerant outlook and recognition of the important part played by the human element in industrial lighting. His own experiences date from 1904. Unhappily when the big consolidating Act of 1901 was being drafted the importance of good lighting was overlooked. We have, in fact, been seeking ever since to secure proper recognition of its value in the Factory Acts of this country. Fortunately the Home Office Factory Department has been able, in the meantime, to do a great deal to bring about a better appreciation of the benefits of good lighting, so that the delay is not entirely a drawback.

After reviewing progress during the last few years and the various agencies for the study of illumination which now exist, Mr. Wilson passed on to the fundamental principles of good illumination. He gave full recognition to the need for sufficient light as an important element in the maintenance of efficiency and the elimination of accidents. But he also pointed out the equal importance of avoidance of glare and of proper shadow conditions. He also emphasized yet another point that is apt to be overlooked—the necessity for clear vision irrespective of intensity of light. This last point has been strikingly illustrated in the hosiery and "linking-in" industry, where the fine and close nature of the work renders the use of special spectacles to relieve excessive convergence and accommodation highly desirable. Evidently no degree of illumination will enable a worker to "see well," if his eyes are unable to preserve the proper focus and form a clear image of the object. This point is of more than casual moment to illuminating engineers, who are sometimes unjustly blamed for "poor light" when it is really the eye-sight of the operators that requires aid.

In the final portion of his address Mr. Wilson enumerated the advantages of good lighting, as an important factor in safety, as an aid to production, in affording a valuable mental stimulus to the worker (who is involuntarily depressed by poor lighting), and in the interests of cleanliness and order. He also pointed out one respect in which lighting differs fundamentally from most other factors in the worker's environment. In the case of temperature and ventilation, convection and diffusion come into play, so that the conditions at any point are approximately reproduced at any neighbouring point. In lighting this is not so. Light travels in straight lines, and it is often possible to find conditions entirely different as between one point and another a few inches removed from it. Hence the solution of a lighting problem may involve special difficulties; but, on the other hand, when once these difficulties have been overcome and satisfactory conditions have been attained, these remain unchanged and unaffected by external conditions which often become such interfering factors in the case of other great divisions of factory hygiene.

Lighting Miniature Golf Courses

IT is odd to read in *The Magazine of Light* that "one of the brightest memories of 1930 is miniature golf." The game immediately became popular in the United States, where before the summer ended something like 125 million dollars had been invested in courses of this nature—almost all intended to function under artificial light, and thus furnishing a useful load to electric supply undertakings. The cost of the lighting installations is stated to have varied from about $150 to $1,700. It is contended that courses of equal attractiveness could count on their popularity being in direct proportion to the adequacy of the lighting system. Actually lighting intensities varied from 1.5 to 10 foot-candles, and consumption from 0.25 to 1.5 watts per square foot. One watt per square foot is stated to be a fair average value.

The illustrations of the courses shown in our contemporary seem not unlike those developed in this country. All the examples shown are, however, out of doors and the area covered is apparently considerably greater than is possible under cover in a hall. It is evident that in America miniature golf courses, already successful in 1930, are regarded as quite promising speculations in 1931. How is one to explain the extraordinary difference in conditions in this country, where the boom was so short-lived?

Without analysing too closely one's experiences of courses under cover, one can understand how interest in them tended to evaporate. Experience of outdoor miniature courses at seaside places, where the distances are so much greater, and where one can, in fact, get quite useful practice for the real game, enables one to understand how these courses continue to prosper. One gathers that in the United States electric supply undertakings, alive to the possibilities of this new source of revenue, have gone out of their way to study the miniature golf course and assist its development. It might be worth while to explore more fully the possibilities in this country. So far as one can judge, the artificial lighting usually provided is of a somewhat perfunctory character. If really scientific illumination were adopted this might in itself go a long way towards developing what should prove a valuable evening pastime.

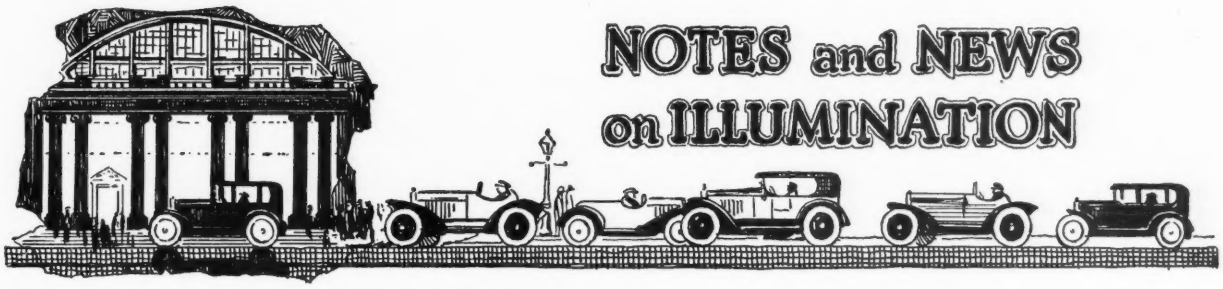
Association of Public Lighting Engineers

EIGHTH ANNUAL CONFERENCE.

The eighth annual conference of the Association of Public Lighting Engineers will be of a somewhat exceptional nature this year, as it will form part of the International Illumination Congress. The conference will take place during September 6th to 8th in Edinburgh, for which city the President-Elect, Mr. R. Beveridge, is Inspector of Lighting and Cleansing. Monday, September 7th, will be devoted to the technical sessions of the Congress, at which papers reviewing various aspects of street lighting will be read. In the evening there will be a reception by the Lord Provost and Council, and an opportunity of inspecting the street lighting of the city will be afforded.

The annual meeting of the Association will be held on the morning of the following day (Tuesday, September 8th).

Members of the Association will be free to take part in the proceedings at Edinburgh, but those who wish to join in the entire programme of the International Illumination Congress (and we hope that many will do so), should enter their names as members of the Congress (for which the registration fee is £2).



The Illuminating Engineering Society

(Founded in London, 1909; Incorporated 1930.)

ELECTION OF OFFICERS AND COUNCIL.

The names of those nominated by the Council to fill vacancies for the Session 1930-31 were circulated to members last month.* One independent nomination for members of the Council, on behalf of Captain W. J. Liberty, was received prior to the limiting date (April 15th), and has been added to the list of applicants who now become automatically elected. The names are accordingly as follows:—

President: Sir Francis Goodenough, C.B.E.

Vice-President: Mr. H. Hepworth Thompson.

Members of Council: Mr. J. Eck, Mr. S. B. Langlands, Capt. W. J. Liberty, Mr. Howard Robertson, Mr. W. Millner, Mr. J. C. Walker and Mr. H. C. Wheat.

The Hon. Secretary (Mr. J. S. Dow) and Hon. Treasurer (Mr. J. Wyatt Ife) are re-elected.

ANNUAL GENERAL MEETING.

The **Annual General Meeting** will be held at the E.L.M.A. Lighting Service Bureau, 15, Savoy Street, Strand, W.C., at 6 p.m. on **Tuesday, May 19th,** when the Report of the Council and the Accounts of the Society for the past year will be presented.

National Safety First Congress

We have received particulars of the National Safety First Congress to be held in Leeds during May 13th to 15th. It is possible that some of the numerous subjects for discussion may afford an opening for some comments on the relation between good illumination and safety. There does not, however, seem to be any paper dealing with this aspect of safety, and this is surely an omission. We would suggest to the general secretary, Lieut.-Col. J. A. A. Pickard, that it would be a good plan to approach such bodies as the Illuminating Engineering Society and the Association of Public Lighting Engineers prior to the 1932 Congress; a few papers dealing with illumination in relation to accidents in streets and factories would stimulate interest on the part of their members as well as providing interesting topics for discussion.

The Second International Congress of the History of Science and Technology

Yet another Congress, under the above imposing title, is being arranged to take place during the present somewhat overcrowded year. The event will take place during June 29th to July 3rd. There will be numerous addresses and exhibits, and the headquarters will be the Science Museum, South Kensington, London, S.W.7, where all communications should be addressed.

* *Illum. Eng.*, March, 1931, p. 52.

Street Lighting in Leicester

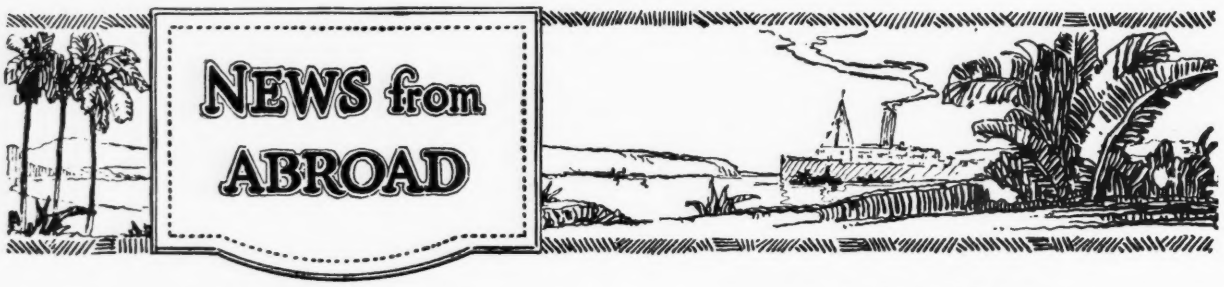
The annual report on the street lighting of Leicester issued by the Superintendent, Mr. Thomas Wilkie, for 1930, is again a record of steady progress. In regard to gaslighting one observes that the number of lamps in use in 1930 (5,784) is slightly less than in 1927 (5,877). Similarly, the total rated candle-power output of the public lamps has remained almost unaltered during these four years, the figure for 1930 being 293,549 for low pressure and 27,250 for high pressure. The candle-power per cubic foot per hour has, however, improved materially, from 27.67 to 29.34. Electric lighting has developed more rapidly. The total number of lamps in 1930 was 1,159, as compared with 517 in 1927, and the candle-power yielded has risen from 100,594 to 267,568. Features have been the continued electrification of tram-routes and the lighting of the widened Charles Street with 500-watt units. Six light-sensitive bridges for the automatic control of street lamps are now in use, and results of experiments so far appear to be promising. The cost of public lighting for 1930 (4.75d. per £) was distinctly lower than in the previous year (5.27d. per £). The ratepayers of Leicester have surely reason to congratulate themselves on such a modest figure.

Floodlighting of Rochester Castle

Floodlighting has been much in the public eye of late. We notice that the Mayor of Rochester, Mr. George Jenner, has been doing manful battle in defence of the night-illumination of Rochester Castle. Some captious critics have been heard to assert that "the idea of floodlighting historic buildings is abhorrent." In London, "where there is so much superfluous light," perhaps; but "where there is beauty unimpaired—at Rochester, for instance—why spoil it?" Mr. Jenner disputes the idea that floodlighting Rochester Keep is inartistic. It enables many people to see the Keep who have no leisure to admire it by day—more, it brings out detail that would otherwise be unperceived. Moreover, if it be an advertisement for the fair town of Rochester, it is at least an artistic one! The *Evening News*, which devoted a column to Mr. Jenner's views, also sought the opinion of one of the group of experts recently engaged in the lighting of Big Ben. We need scarcely add that he endorsed Mr. Jenner's defence of floodlighting.

Street Accidents

The issue of the Home Office Report on Street Accidents is an annual reminder of the seriousness of the problem of street-dangers. Nothing apparently can stem the rising tide of accidents, though it may well be that the increase would have been still more serious but for the educational and remedial measures taken during recent years. Howbeit the figures are grave enough. In England and Wales the number of persons killed has risen from 5,990 to 6,522, and the number of injured from 162,109 to 168,502. In Scotland the increase in the number of fatalities, from 706 to 783, was about 11 per cent., almost the same percentage as in England.



Illuminations at Exhibitions

We commented recently on the important place that illumination is assuming at international and national exhibitions. Some of the devices adopted at the recent exhibition in Anvers, and illustrated in *Lux*, are of a decidedly original character. At the British Empire Exhibition, Wembley, floodlighting of foliage and the design of strong luminous creatures floating on the lakes was regarded as a novelty. At Anvers such ideas have apparently been combined with moving signs. Thus in the pictures accompanying the original article not only do luminous swans float on the surface of the lake, but a flight of wild geese is seen in the background. Another scene staged ("the snake-charmer") shows a mass of serpents in motion. At the French Colonial Exhibition of 1931 lighting is also playing a big part. Here again there are novel ideas, one being the "bridge of water," created by numerous spray jets from either side of the lake uniting to form an arc illuminated by means of concealed projectors. We also notice that rectangular luminous columns, of the type that has recently become popular on the Continent, were used with good effect to illuminate the grounds of the Exhibition at Anvers.

Practical Points in Architectural Lighting Design

Architectural and decorative lighting schemes are based very largely on the use of "built-in" designs of the type mentioned above. In the usual note on "Light in Architecture and Decoration," in the March issue of the *Transactions* of the Illuminating Engineering Society (U.S.A.), Mr. Ward Harrison suggests a searching query: "How will these installations look in 1935?" Designers are absorbed in the study of effect; have they considered sufficiently practical design? Mr. Ward Harrison propounds four additional tests for such installations: (1) Are the reflecting surfaces permanent, and will they withstand heat? (2) Are the equipments reasonably accessible for cleaning and re-lamping? (3) Are the luminaries dust-tight or practically so? and (4) What types of lamps are required and how installed? These, he suggests, are the factors that will determine how the installation will look in 1935. Too many attractive-looking jobs are designed with no thought for the morrow. Reflecting surfaces consisting merely of white paint in close proximity to lamp-bulbs are sure to turn brown and peel off. Chromium, aluminium, porcelain enamel and the best mirrored glass are about the only reflecting surfaces that can be relied upon. It has been suggested that "the average illumination in the United States would be doubled to-night if all lighting equipments were thoroughly washed to-day."

There is, doubtless, truth in the suggestion that decorative lighting is sometimes installed without much regard to permanence. It may, however, be argued that much of the lighting of this type is ephemeral and is liable to be remodelled at frequent intervals owing to changes in popular taste.

"Built-In" Lighting

An entertaining contribution by Mr. A. L. Powell and Mr. Alston Rodgers, issued by the Nela Park Engineering Department (Harrison, N.J.) defines "built-in" lighting as forming a component part of the building, and such that it cannot in general be applied to a structure that is entirely finished. This is, in fact, an approach to "architectural lighting" in the literal sense. The article illustrates the design of numerous types of luminous boxes, which may become ceiling or wall panels, luminous borders to windows, etc.. A similar device is the building of designs out of massed luminous cubes of standard type. The selection of diffusing glass, and the relation thereto of lamp spacing is discussed—this is really quite a serious point in design in order to avoid patchy effects. Good and bad methods of cove and cornice lighting are illustrated. The latter part of the article deals with special types of wall fittings and devices which more properly come under the head of spectacular lighting, e.g., luminous flowers, projected light-patterns, etc. The formation of the latter seems quite a novel and legitimate method of getting decorative effects. This leads to what is perhaps the latest and most ambitious effect developed in the United States, the "colorama," which is based on massed patterns of coloured light capable of progressive variation.

Illuminating Engineering in Sweden

We have been favoured with a copy of yet another monthly publication devoted to lighting, *Ljuskulture Manadsbad*, which is issued by the *Svenska Föreningen för Ljuskulture*, the organization responsible for the recent exhibition of lighting in Stockholm. The number before us illustrates the illlumination of a kinema theatre on "architectural" lines, and there are numerous effective photographs of street-lighting installations. One view of a street in Halsingborg suggests very bright lighting indeed. We notice a table of suggested minima for illumination in various classes of streets. This seems not very far removed from the British Specification, as the first class of street is assumed to receive 15 to 20 lux (say 1.5 to 2 foot-candles), and the fifth class 0.5 to 1 lux (say 0.05 to 0.1 foot-candles).

New Methods of Demonstrating the Benefits of Good Lighting

In the current issue of *Das Licht*, Mr. O. Höpcke suggests various methods of exhibiting the advantages of good lighting, based on actual performance by good and poor illumination. He presents, for example, data on typesetting (apparently derived from the familiar experiments of the Illumination Research Committee in this country). These data are assembled in a popular table under the title "What Does *Bad* Lighting Cost?" A calculation based on output and wages shows that the cost of improved illumination is small in comparison with the better output secured.

TECHNICAL SECTION
COMPRISING
Transactions of The Illuminating Engineering Society and Special Articles
The Illuminating Engineering Society is not, as a body, responsible for the opinions expressed by individual authors or speakers.

Modern Domestic Lighting

By H. T. YOUNG, M.I.E.E.

(*Paper read at the meeting of the Illuminating Engineering Society held at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London W.C.2, at 6-30 p.m., on Thursday, March 19th, 1931.*)

Introduction.

The story of the "Development of the Art of Artificial Lighting" down the ages has been told quite recently in a fascinating way by Dr. John Walsh in his lectures at the Royal Institution, but a short review of the influences that have brought about the more recent advances in modern domestic lighting seems desirable.

Twenty-five years ago a 16 candle-power carbon filament lamp was considered a powerful light for a sitting-room or dining-room, and it was thought extravagant to use more than an 8 candle-power lamp in a kitchen. 5 candle-power lamps were in common use in passages. Existing gas and candle fittings, also oil lamps, were adapted to electric light, and the few new electric light fittings employed were nearly all imitations of existing forms.

It must also be borne in mind that electric light was then more of a luxury than it is to-day, and available only to a comparatively few residences.

During the twenty-five years that have passed, the scientist and engineer have worked together and made possible the comfort and pleasure we derive from electric lighting to-day. The robust tungsten filament vacuum and gasfilled lamps have been perfected. Methods of generating and distributing electricity have advanced tremendously, as also have the applications of electricity in the service of mankind.

Thus with the improvement in the incandescent lamp, from the very yellow carbon lamp (giving approximately $\frac{1}{4}$ candle-power or 2 lumens per watt) to the whiter tungsten lamp (giving approximately 1 candle-power or 10 lumens per watt, this depending on size and type), the great developments in generating and distributing electricity and the enormous increase in consumption, due to the large and diverse uses to which it is put, we are now able to obtain electric light at a cost which enables us to use it in greater quantities, not only from a purely utilitarian point of view by providing higher intensities, but as a definite decoration to our homes and a means of either rest, interest or stimulant, just as it may be required.

Incidentally, its cost compares most favourably with all other countries in the world. Added to that we have greater reliability and better quality than most other countries. By better quality is meant more constant voltage with a steadier light.

Another important factor bearing on domestic lighting is the introduction of the two-part tariff, by which, after a certain sum based on size of residence or rateable value, a small charge of from $\frac{1}{2}$d. to 1d. per kilowatt-hour is made.

It is now no longer necessary to pay the policeman 1/- for calling you up at night to switch off the porch light as, where the two-part tariffs operate, a 30-watt lamp can be used over 30 hours often for about $\frac{1}{2}$d.

The following figures illustrate the rapid development in the generation of electricity, and, of course, the more it is used the cheaper it will become.

			Million units
Board of Trade units sold in	1905	...	448
,, ,,	1925	...	4,600
,, ,,	1930	...	8,600

Decorative Aspect.

In the past five years a complete change has come over the civilized world's outlook on domestic electric lighting. For this change we owe much to France and Germany. The exhibition in Paris in 1925 without doubt established the foundations of the new era. The architect and decorative artist have discovered the "Art of Lighting," the people of the world have appreciated it, and now it is rapidly becoming the dominating feature in internal decoration.

We as engineers should admit frankly that the development of lighting into a distinctive "Art" is due to the artist, and we should make every effort to assist and encourage co-operation from this new quarter.

An immediate problem is how best to bring about close and effective collaboration between the artist and engineer. How can this be done?

A necessary first step is that the engineer should remove to the inner recesses of his mind and to the tail-end of his vocabulary that word "Efficiency." This process may not be easy, as the whole of his training in the past twenty-five years has been centring on that word. He has been trying to save watts for so long, and, as he must, by his training, save something, he can to advantage turn his mind to watching his volts. To-day, and for the future, "Effectiveness" must come first.

Secondly, standardization, which is so important to the engineer in nearly all his work, must give way where art is concerned with modern lighting.

The true artist abhors standardization. Possibly at

no other time in the history of the world has creative or applied art been itself in such a state of flux.

The speed at which we live and work to-day demands change and variety in our homes.

It is for the illuminating engineer to accept this and cultivate and encourage the designer. By "Designer" is meant a man who is fully aware of all that the word "Design" implies, and not the hack designer who covers the pure, clean products of science with an icing of meretricious and useless ornament.

This, at first sight, may seem to entail sacrificing the skill of the engineer for that of the artist, but it really requires greater skill to put into operation the lighting schemes of to-day as created by the artist than was required in the past years for the purely utilitarian methods.

Also inestimably greater pleasure is given to the work by its greater diversity, its endless surprises, and the joy it brings to the user.

It is necessary to keep in mind the great change that is also taking place in domestic architecture, furnishing and decorations, but in all these other applied arts none has advanced so far or so rapidly as lighting.

While great controversy rages round change from traditional to modern in architecture and furnishing, we are in the fortunate position of possessing no real tradition.

It is true to say that electric lighting design laboured too long under the handicaps of methods used for gas and candles, which required access for air and vents for the escape of products of combustion, also access for kindling the flame, and that when the modern artist came to be interested the results he achieved were so sensible and so fit for their purpose that lighting quickly caught up with the general trend of modern design, and is now dominating the field.

It is not contended that artists and designers are infallible, but most of them to-day understand their public. Neither is it contended that either the illuminating engineer or artist will pay no regard whatsoever to standardization or efficiency. The domestic quarters such as kitchens, pantries and larders still give scope for these.

Of course it will not be possible for the masses of the people to whom electricity is now available to have each fitting specially designed, but even in very small homes there should be no necessity to limit the lights to one per room or to adopt one type of fitting for lighting a house or apartment throughout. It is interesting to notice that greater attention is being paid to design generally on the part of most of the manufacturers of the cheaper forms of fittings. It is also good to see that those responsible for the electrical showrooms of the country are selecting fittings with greater discrimination than ever before.

Lighting Design.

Modern domestic lighting design to-day can be divided under six main headings:—

1. Designs where the light source or lamp indicates or governs the shape of the fitting, such as in the tubular style.

2. Designs using interesting shapes, chiefly constructed of glass housing ordinary incandescent lamps.

3. Architectural designs with panels, cornices, windows and such like forming an integral part of a room.

4. Indirect lighting above cornices and behind opaque panels and plaques, lighting of curtains, tapestries and pictures.

5. Portable lighting with illuminated vases, standard lamps and other pedestal fittings on floors and tables, and an occasional illuminated ornament.

6. Plain two-part dust-proof fittings.

No. 1 is possibly the least understood by engineers, and yet it should be the easiest to understand. It is a sincere attempt to allow the shape of the light source to govern the shape or form of the fitting, in the same way that the requirements of the modern turbo-alternator decide its form. Multiples of tubes make interesting fittings, either hanging vertically in the form of pendants or fixed horizontally and vertically to walls and ceilings. A single tubular unit is very effective and suitable for a low corridor, and looks well in the middle of a rectangular room. Interesting lines of light can also be obtained with this system.

No. 2. These shapes are designed to house ordinary incandescent lamps and usually consist of panels of glass, sometimes bent, supported on metal fixings, and the whole forming a design either for ceilings or walls.

No. 3. Architectural lighting is the most interesting of all, and is a term now applied to all forms of lighting forming an integral part of the room construction. This is usually at its best in restaurants, theatres and shops, and this way of lighting public places has helped people to appreciate the great value of lighting in their homes.

It is more difficult to introduce into residences, as it usually calls for special work in the erection of the house or structural work in connection with the installation. These considerations, and also the fact that it is not so easy to change, stand somewhat in the way of its development domestically.

It is usually best employed in rooms where the lighting requirements are least likely to change, such as bathrooms, dining-rooms, entrance halls, corridors, and in some bedrooms.

An important point for both the designer and engineer to bear in mind when fitting large illuminated surfaces in a room is that the light source must be bright to be interesting. Mistakes are already being made in the attempt to spread out a small amount of light over too large an area.

No. 4. Indirect lighting. The thought of this is usually fascinating, but it has suffered in the past from the fact that people installing and using it did not quite understand the reaction of the human eye and brain to artificial light.

Glare is intolerable, but indirect lighting from ceilings without assistance from low interesting visible light sources somewhere about sight level is tiring and depressing. It promotes a feeling similar to that which is experienced in a pit.

The best lighting of to-day and, possibly, of the future seems to be a combination of indirect with direct light sources.

The lighting of window curtains is most pleasing and always tends to give depth or breadth to the room. It is a simple job to fix a properly shielded piece of narrow reflector taking tubular lamps in front of the curtains, or to fit a lamp into or behind a piece of furniture. Velvets and similar materials light up particularly well.

Picture lighting not only serves to light up a picture, but when properly executed is a great asset to the decorative effect in a room.

No. 5. Portable lighting fittings for sitting rooms and bedrooms bring the greatest comfort and give the user greater scope for personal expression and change.

Furniture, such as dressing tables, dressing mirrors, wardrobes, sideboards, cocktail stands and

bars can with advantage to the user be designed with the electric lighting embodied in them.

Well-designed table and floor lamps, with soft-coloured shades, can be placed in positions both for use and decoration, while a coloured vase with a light on top covered with a shade, and sometimes a lamp inside the vase, will give a bright splash of colour and interest to any room. A useful lamp, employed in every home in the United States but absent from the English home, is the Bridge lamp. It stands on the floor, is light, portable and adjustable, and can be moved with ease to any part of a room. We could, with advantage, use this style of light in this country.

Ornaments of one kind or another will not be dispensed with in our time, so we must do our best to make them more attractive with light.

An illuminated gold-fish pond, with glass fish in water with a little colour, is far more attractive than a dull bowl with live fish, and less troublesome. Some illuminated glass figures now made in this country are considered by many people to be really beautiful.

No. 6. The plain two-part dust-proof fitting for kitchen, pantry, scullery, larder, and such like, has many advantages over the old plain pendant of the past. It usually consists of a white-enamelled gallery fitted with a simple clip or screw to carry an opal glass globe with a lamp inside. This forms a reliable unit, clean inside, and easily cleaned outside.

Fittings.

The manufacture of the modern fitting, whether it be an architectural feature or otherwise, calls for considerable thought in the selection and assembling of materials.

In that part of the year when artificial light is most required, we, in this country, suffer from changes of weather conditions that do not exist in many other countries, even in the greater part of our nearest neighbour, France. It does not, therefore, follow that all materials used in other countries will suit this. Take for instance, heavy cast or moulded, figured and sandblasted glass. This was used extensively and successfully on the continent, but over here, particularly in and around our big cities after humid days and foggy days, this glass quickly becomes yellow and dirty, and the cleaning of it is a most difficult operation.

Glasses of moderate thickness, with smooth surfaces or one side only sandblasted, are now made with interesting mixtures of opalescent shades. These seem to be most suited to our climate.

Treatment of metals to prevent oxidization or tarnishing calls for special care. Stainless steel and chromium plating are both being rapidly adopted, and for colour effects cellulose paints sprayed on to metals are quite successful.

All fittings should be constructed in such a way as to be easily cleaned and easily relamped. This is often very difficult, and calls for special skill and ingenuity on the part of the man who makes the fitting.

The so-called dust-proof fitting should be designed with greater care, so as to ensure a close joint between the glass globe and its carrier or gallery.

All glare, and even risk of glare, should be avoided. No lamp should be used unless shielded by a diffusing or semi-opaque medium.

Ventilation.

Ventilation is necessary where silk or inflammable material is in close contact with the lamp, also for fittings where lamps above 100 watts are confined in small glass globes or housings. Where ventilation is necessary, a fitting should be so designed as to prevent dust accumulation as far as is possible, either in the fitting or on the wall or ceiling adjacent to it.

Practical Application.

Lighting intensities are important, but with the developments that are taking place it now becomes more a matter of taste than anything else, but somewhat as a guide the minimum might be placed as follows:—

	Foot-candles
Dining-Room :	
Table	4-5
Sideboard or Carving Table	5
Sitting-Room :	
Adjacent to chairs for reading	4-5
General lighting when required	3-4
Bedroom :	
Dressing Table	5
Bedside	3-5
Bathroom :	
General	4-5
For mirror	5-7
Kitchen :	
Table	5
Cooker	4-5
Scullery and Pantry :	
General	4-5
Corridors	2-3
Staircases	2-3

It is impossible to lay down rules for the number of lights required in any particular room, but the examples shown on the slides indicate that much more provision will be required in the future than in the past. To allow 15 ceiling points for 60 watts each and four other lights in addition for a dining-room is not extravagant. The total load as shown in one slide is 1,000 watts, costing less than 1d. per hour to run. The same loading for a sitting-room is quite reasonable, and compares very favourably with the cost of an hour's enjoyment on the part of one person only of cigarettes, and it is less selfish.

Some Examples.

Dining-Rooms.

Wax candles are still in use for dining tables but the fashion is rapidly dying out. The people who use them have mostly inherited candelabra and wish to exhibit them to their friends. This system is now nearly always supplemented with electric light, and when families dine alone the candles are not often used.

Fig. 1.—A Dining Room, as described in this paper, with interesting panel lighting in the ceiling to give a restful, well-diffused light over the Dining table, with a simple tubular fitting to light the serving table, and a small table lamp as an additional interest.

A soft light is usually required, and a very slight amber tint in a good strong light of 4 to 5 foot-candles on the table is ideal to-day. A method of achieving this, apart from suspended fittings, is to fit panels to the ceiling over the table and the illustration shows a framework carrying 15 panels, each 8 ins. square with 2 ins. dividing fillets. The panels are faced with an oiled paper with a slightly mottled amber tint, and behind each panel is a 60-watt lamp in a silvered glass reflector.

The carving table or sideboard is lighted with a tubular fitting containing a 60-watt double-ended lamp, round which is fitted an adjustable reflector, and it gives 6 foot-candles for carving. A small table lamp is on the opposite side of the room near to the window curtains to give depth and interest to the room.

The walls are parchment colour and the ceiling a cloudy blue.

It is always desirable to be able at will to light the ends or corners of the room.

Sitting-Rooms.

In the example given the room has one centre light with opalescent glass panels and a few hardly noticeable streaks of amber. The fitting contains four 60-watt pearl lamps. There is one floor lamp 5 ft. 9 ins. in height with an 18-in. peach-coloured silk shade containing a 60-watt lamp. This lights the side of the room for the piano. The two vases with 60-watt lamps stand on tables in two corners. In addition the curtains are lit with four 30-watt tubular lamps in reflectors on the ceiling, shielded from view by a narrow wooden fillet coloured to match the ceiling, and a small amount of light is introduced through a stained-glass window. The walls are panelled in dark oak up to a height of 7 ft., and the frieze and ceiling are a medium blue.

FIG. 2.—A Drawing Room, showing the intimate character which can be given to a room by the use of table lamps with softly-tinted shades, and the interest which can be given to the curtains by overhead lighting.

With all lights on it is possible to read, write, and sew with comfort anywhere in the room, and with the centre light off it is possible to do the same near the portable lights. The decorative effect with the centre light off is particularly pleasing.

With the centre light only the room becomes depressing and appears smaller than it is, chiefly because the dark panelling absorbs most of the light that falls on it.

Sitting-rooms, libraries, and similar rooms require a centre light more for general utility than decoration, and it should be possible to turn off this light and use portable and/or wall lights and other diffused methods for decorative effects and comfort.

Bedrooms.

Local lighting is essential either from a standard lamp at the bedside or from a lamp over the head of the bed, and this must be easily controlled by a switch from the bed.

Dressing-table lighting can be achieved effectively in many ways. The fashion to-day is to have tall lamps with semi-opaque shades made of celastoid or some similar material. Another way is to fit tubular lamps shielded with opalescent or frosted glass to the mirror framework, and still another ingenious way is to use a mirror with a frosted border having the light introduced around this border.

FIG. 3.—A Bedroom. Corner lights have been used to light this bedroom, and additional interest is afforded by an illuminated mirror, and two bedside lamps.

Good general light is necessary in addition, also provision for a portable lamp near the fire. A light for each wardrobe and cupboard is necessary, and there is usually room for this in one front corner close to the door.

Bathrooms.

Bathrooms require a good general light, also a local light near the mirror and basin unless the room is very small, when the mirror light can be designed so as to light the room. Lights should not be placed so as to show shadows on the blinds.

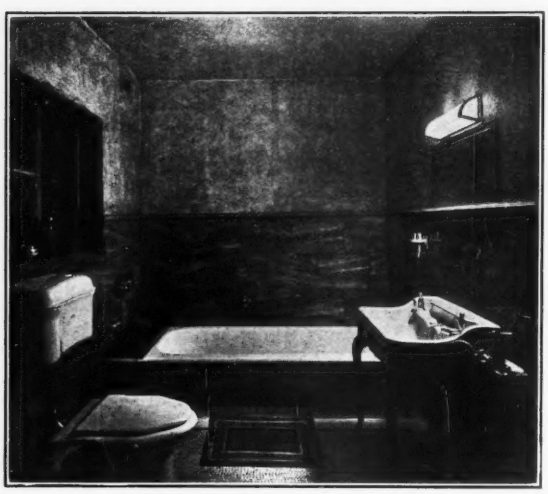


FIG. 4.—A Bathroom: An excellent example of a clean and efficient but decorative bathroom lit entirely from one wall light over the mirror.

Kitchens.

Kitchens require a centre light over the table, of dust-proof type with plain or opalescent globe. A second light, fixed permanently to the wall near the cooker, is desirable. The centre fitting should be either of ceiling or down-rod type and the cooker light either similar or of wall type. Flexible cords and portable lamps should be avoided.

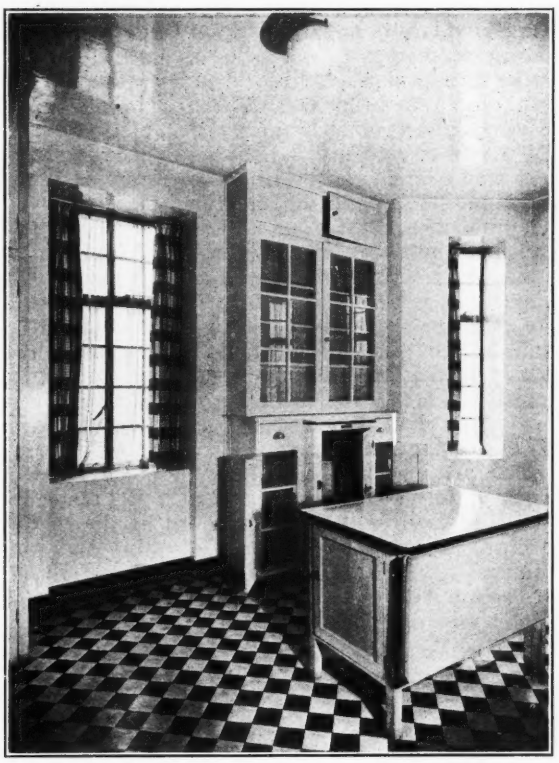


FIG. 5.—A Kitchen, in a flat of a large modern Block. Everything is made and planned for efficiency and saving of labour, with built-in Refrigerator and totally enclosed Opal Ceiling Light. This type of Kitchen is the solution to the servant problem.

Pantries and Sculleries

Should always have a light over the sink or draining board. In large rooms a centre light is also necessary. The fittings should be similar in design to kitchen fittings.

Staircases and Corridors.

Low-hanging or long-protruding fittings should be avoided, as they get in the way of household steps and transportable baggage.

Architectural lighting with semi-flush panels or angle lights are the most satisfactory.

Flush panels should generally be avoided unless they are placed on both sides of the walls. A semi-flush panel protruding only two inches from the wall, with glazed sides, allows a diffused light to fall on the wall surrounding it, and gives the true width to a corridor and better light. Staircases should always be lit from above and below, so as to protect the treads and risers from shadows, and to prevent persons ascending and descending from "getting in their own light."

Porch Lighting.

Before leaving this series of problems in domestic lighting, some reference might be made to the method of lighting the porch, and the approach to the house, and of revealing its name or number. Very many town and country houses, even to-day, are equipped with no form of exterior lighting whatever, and the name or number is indistinguishable by night. In other cases the light in the porch is of crude design, throwing light directly into the eyes of the visitors, and destitute of artistic merit.

It should be the duty of a householder to illuminate his front-door step and, if possible, also the pathway to the road. The source of light effecting this should be screened to prevent glare, and its incorporation in the scheme of the porch offers an attractive problem in design. In most cases it should not be difficult to arrange for such a light also to illuminate a boldly executed house-number, for the benefit of strangers to the neighbourhood.

Colour Lighting.

Coloured light has never found favour in homes in this country. Our lamp manufacturers endeavoured to interest the public with coloured lamps four or five years ago, but were not very successful with the domestic user. The colour of the light emitted from the tungsten lamp being itself more yellow than the light of day, gives a pleasant and warm feeling to any room. If coloured lamps are used, they tend to make a room feel heavy. This is caused partly by the reduced light, but chiefly by very definite colour. Sometimes a little light amber or pink colour can be used advantageously, and it is better to apply the colour to the medium in front of the lamp or reflector behind it. By this means a more luminous appearance of delicate warmth is given to the room, an effect which is in direct contrast with the rather heavy and depressing light from tinted lamps.

Electrical Details.

When installing the wiring it is desirable to provide for 50 per cent. margin over the known or estimated load and to allow for as many plug points as possible. Two-way and multiple switches for controlling lights from two or more positions are a necessity for corridors, staircases and some rooms.

FIG. 6.—A Staircase at a House at Follifoot, Yorkshire, where the simple Lighting Fittings have carried out the form of the built-in staircase under the supervision of the architect, R. D. Russell.

Automatic switches for turning on and off lights with the opening and closing of cupboard and wardrobe doors are very convenient, and they are now quite reliable.

Whenever possible the lighting of rooms should be arranged on two fuses so that little inconvenience is suffered if one fuse blows. Fuseboards should be fixed in easily accessible positions. Switches should be kept away from taps and radiators, and where fixed in bathrooms, kitchens, near stone floors or in damp situations should either have their dollies and covers "earthed" or insulated.

Metal fittings fixed in bathrooms and within reach of persons standing on stone or damp floors should also be earthed.

Artificial Daylight.

The technique of domestic electric lighting as a result of developments over the last five years has now become a subject that requires closer study on the part of the electrical and illuminating engineers and designers as well. Not only is the light source and the shape and arrangement of the fittings important, in this new applied art, but a better understanding of the human reaction to light is also most essential.

Most people live in homes to-day that are inadequately provided with daylight, with windows usually too small and often badly placed. This is forced upon us by architectural tradition, and is a heritage from the past.

Some theorists advance the idea that the ideal way of lighting by artificial means would be to copy daylight and use windows. This would be satisfactory and pleasing for rooms that receive no daylight at all and during, possibly, twelve hours of the day, but the appearance of perpetual daylight brings with it monotony at night.

When the hours of daylight are over, a change in lighting intensity and direction, with flexibility of control, makes the life of the average individual more congenial.

It is the duty of those engaged in this interesting work to lead the user to a better understanding and appreciation of this great and indispensable influence in the service of man and woman, and it is good for us to know that we have in our own country creative designers who know how to apply it.

(The lecture was illustrated by a number of attractive demonstrations of modern lighting equipment, one specially effective display being the illumination of velvet curtains by sources concealed along their upper limit. Mr. Young also showed a great variety of lantern slides. Most of these were complete installations, many of them due to the skill of British architects and designers. There was also a series of three slides designed to illustrate the variation in daylight with the time of day and the period of the year, and its unequal distribution in the average interior lighted in the ordinary manner by side-windows.)

It was pointed out that in such circumstances daylight illumination is very far from uniform—as is sometimes assumed—and that the "diversity factor" is in general far greater than would be the case in an interior lighted in an approved manner by artificial light.

Finally, it may be mentioned that the choice of the lecture theatre of the Institution of Electrical Engineers for this meeting proved a happy one; the original method of lighting, which was new to a number of those present, aptly illustrating some of the ideas under discussion.

Discussion

Dr. J. W. T. Walsh heartily congratulated Mr. Young on his paper, which, he said, was one of the most interesting the Society had ever had. The interest had been greatly increased by the demonstrations and the wonderful series of slides shown.

He believed that he was not alone in thinking that home lighting was perhaps the key subject of illuminating engineering, and for three reasons. First of all, the standard of suitability and effectiveness in the lighting adopted in people's homes set the standard for the effectiveness of the lighting wherever they went. If illuminating engineers got the lighting in the homes of this country up to the standard at which they would like to see it they would have taken a great step towards ensuring the progress of illuminating engineering in all its branches. There had been numerous papers on the lighting of offices, factories, and other large places. Although the lighting of a single home was a small problem in comparison, yet when it was remembered that there were eight to ten million homes to be dealt with it would be seen that there was a tremendous field to cover, and that the task of raising the standard of domestic lighting was a far larger one than any to which they had hitherto set their hands. The lighting of the home gave the exponent of modern lighting art a fruitful field for study. An almost infinite variety of conditions and personal tastes had to be contended with. The modern lighting artist, therefore, would find in domestic lighting an almost boundless field for the exercise of his ingenuity and an opportunity of adding enormously to the standard of comfort of the people.

Perhaps Mr. Young had intentionally not referred to the lighting of the garden. It might seem a little strange to bring it under the head of domestic lighting, but in the case of most people the garden and the home went together. No doubt other members of the Society besides himself had had the opportunity of seeing the very charming lighting installed in the garden attached to the home of a Past President of the Society. The effect after dark of the concealed lighting, seen through large French windows, was very pleasing: charming results could be secured on a modest scale.

He would like to put in a plea for the occasional use of the candle, which Mr. Young was inclined to dismiss as an obsolete device. After all, if one had really artistic candelabra handed down from previous generations, was it not better to put candles into them and show them to friends than to put them away in a cupboard?

The use of luminous gaseous tubes for home lighting was perhaps premature, but it was quite a conceivable development in the future, and he commended this idea to Mr. Young.

Mr. T. P. Bennett said he had the greatest possible pleasure in associating himself with the congratulations offered by Dr. Walsh. As an architect, he felt that Mr. Young had shown that illuminating engineers had a great deal of regard for the psychology of the person using domestic lighting, and an appreciation of the possibilities of the artistic use of light, and that they did not merely confine their attention to the purely practical side of the work.

Mr. Young, in his concise survey, had covered all the fields of domestic lighting, and he submitted to the meeting something really interesting and modern.

The use of reflected light brought into play a very large number of considerations not present when dealing with the more direct use of light. He had lately done a great deal of experimenting with reflected light, and had found it extremely difficult

to get the surface next to the lamps sufficiently matt to eliminate troublesome polished reflections. All sorts of things had been tried, but complete diffusion had not been obtained. Perhaps lamp manufacturers would be able to provide a form of shade which would not cut off a large amount of light but yet would give a uniform distributing effect. Some surfaces were apt to collect much dust in a short time and to reduce the intensity of the illumination, thereby destroying or modifying the original effect aimed at. The selection of colour for shades and reflecting surfaces was often of importance: quite different results were obtained if the same lamp was used with a pink or yellow material.

Such points were of considerable consequence to the lady of the home, who naturally preferred a mode of lighting which enabled her to look at her best. Similar considerations might affect the lighting desired in the bedroom. He recalled a lady client, who insisted on having a single lamp of high wattage, giving a very hard light, over her dressing-table. She argued that if she looked all right by this light she felt perfectly safe whatever the lighting conditions she might encounter elsewhere!

Absence of glare was of vital importance. If the filament was imperfectly screened a great strain was put on the eyesight; such conditions were exceedingly bad for the health and the nerves. The position of lighting elements in a building was also of great consequence. Designs might be interesting, and possibly original, and yet their value might be largely destroyed by incorrect positions being assigned to them. It was difficult to induce foremen to realize the importance of accuracy in this respect, even when they were supplied with complete properly dimensioned drawings. Lack of care in this connection not infrequently led to alterations and corrections at the last moment.

He congratulated Mr. Young on his paper, which was an excellent one.

Mr. R. WALDO MAITLAND congratulated Mr. Young on his paper. Domestic lighting was, in reality, a difficult problem.

The lecturer had suggested that "lighting is becoming the dominating feature in internal decoration." This might be true, but it did not follow that this course was right. If light were employed for the purpose of decoration, as suggested, it was apt to conflict with the other elements of the interior. For example, to introduce a medley of light sources in a comparatively small interior, especially at eye level, produced an extremely irritating effect, and made the atmosphere of the room restless—which was the opposite to the effect one desired to produce. A room, in order to have a really restful and fine effect, should employ a minimum of light sources; to this end the introduction of a central fitting, either as part of the ceiling design or slightly below the level, with the few necessary table and floor standards for local lighting with a suitable quality of light, would produce the restful and comfortable effect required.

Mr. Young had also suggested that when indirect lighting is used (presumably where the centre of the ceiling is utilized as a reflecting surface) one should place wall fittings at eye level. He (the speaker) thought that this was probably the worst form of indirect lighting. Moreover, fittings in the line of vision were decidedly irritating, especially in the case of dark walls. If such fittings were adopted, light walls were desirable; even so, unless the comparative brightness of fitting and wall showed little variation, such application was not desirable. The effect of dullness could be overcome if the indirect lighting was localized in the form of a fitting designed as part of the ceiling, say about half the length of the room, and if sufficiently confined to a limited area would give a simple and pleasing effect. This method, he felt sure, would overcome many difficulties and compare favourably with other systems of lighting from a central point.

He was afraid that he did not agree with Mr. Young's suggestion that a large illuminated surface should be bright in order to be interesting. Surely the whole idea of modern lighting was to cover larger surfaces, with a resultant low surface brightness. This was surely one of the important contributions to modern illumination, and the principle can be carried out on a smaller scale to suit the conditions of domestic needs.

There seemed to be rather a tendency towards utilizing light merely for the sake of novelty. This was probably a phenomenon quite natural to any new phase. Such an effect had already occurred in modern architecture, but now it had established itself. Lighting would have to follow, and be taken far more seriously, and be applied logically and scientifically, for this lighting had come to stay, and unless it was carefully considered our architecture would suffer.

Mr. S. CHERMAYEFF said that the last speaker had to some extent, anticipated his remarks. He wished to congratulate Mr. Young on his paper, and on the numerous charming designs which he had produced. He was not sure, however, that the designer should be encouraged quite to the extent that Mr. Young had suggested, and he felt that the engineering side of illumination should not be entirely overlooked. There were really two distinct aims in illumination—lighting for a definite purpose and lighting for effect, and in some cases the former aspect took precedence. Sometimes the best effect of all was obtained by very simple measures. He had just returned from Germany, where he had had the privilege of seeing Mendelssohn's (the famous German architect's) house. A pleasing and dignified appearance was obtained by the use of a single indirect-lighting unit consuming 150 watts. There was no kind of effort to obtain "a pretty effect."

Mr. C. RAPHAEL, whilst in the main agreeing with the principles expressed by Mr. Young, remarked that he could not endorse entirely the execution of the work in accordance with those principles! He might be old-fashioned, but, in his mind, jazz fittings, some of which had been shown that evening, and some of which members had recently seen in showrooms and trade papers, verged on the hideous. Although, no doubt, interesting enough, they were freaks and not artistic. To lay it down that that was the modern tendency of domestic lighting was, he thought, rather unfair to those who had not adopted such types of fitting. After all, they had to remember that the paper was on domestic lighting, and not on the lighting of public buildings. The furnishing and decoration in many instances was meant to represent a definite period, and could not fairly be called old-fashioned. To introduce, in such cases, some of the things now seen would, in his opinion, be an obvious mistake. Houses of no period could be decorated, lighted, or furnished entirely to the taste of the individual occupier. Sometimes taste was absent. In many instances 15 light points in a dining room might well be regarded, not merely as extravagance, but as vulgar ostentation. It was true that in one of the installations shown by Mr. Young the whole of these 15 points were assembled over an artificial skylight. The effect under these circumstances was less dazzling, but such a method must naturally prove expensive, and he did not think that such elaboration was necessary in domestic lighting, unless the object was pictorial effect. If he had to light a public

building he would say to the architect: "Do you wish the lighting fittings to be a feature of the decoration, or am I to light your architecture?" Usually there was a compromise. (Laughter.)

The slides had shown some beautifully lighted rooms, nearly all of which he admired very much, even if he did not always agree with the distribution of the light. He thought that the last slide (which the lecturer had exhibited in derision) had shown a pleasant, comfortable, homely room. He should dislike living in some of the other rooms that had been shown, and he thought that that view would be shared by the ordinary domestic consumer.

He wished to thank Mr. Young for his paper, which helped one in fixing ideas. Even if it only led to ideas definitely in disagreement, it was all to the good!

Dr. N. A. HALBERTSMA (Holland) congratulated Mr. Young. Even those who did not quite agree with the paper regarded it as excellent. There were points in it which really should be underlined. He believed that they represented what was meant by illuminating engineering.

With regard to the difference between efficiency and effectiveness, the use of the word "efficiency" was often abused. Efficiency was the right term in several fields of engineering, but it was not the predominant feature of one's motor-car or breakfast. (Laughter.) There was something in the art of seeing and the art of lighting that was not wholly a question of efficiency. Since 1925 the importance of lighting architecture had been realized in a way which nobody could have anticipated. We had become accustomed not merely to think of efficiency, but rather to strive after effectiveness. "Efficiency" might be determined by Dr. Walsh at the National Physical Laboratory, but "effectiveness" must always be a question of taste.

Speaking with all respect, he did not think that in ten years time more than 10 per cent. of British homes would have such lighting systems as Mr. Young had shown. Even if the market was oversupplied with new devices it was not to be expected that the old-fashioned things would disappear altogether.

Adequate architectural illumination had only been made possible by the decreased cost of electrical energy. It made all the difference whether the unit cost sixpence or eightpence, or only a penny or a halfpenny.

Mr. RAYMOND MCGRATH said that he had found the lecture very entertaining, and that he considered the slides very valuable.

In these matters, after all, if one had the money, he would wish to spend it in securing something that he liked.

M. MAISONNEUVE (France) said that the paper was excellent. Mr. Young had compared the cost of home illumination with the cost of cigarettes. There was another comparison which was very interesting, namely, a comparison with the old candlestick. He had made a simple calculation, and found that, comparing the service got from a 25-watt lamp with the service from 25 candle-sticks, the candles burning for three and a half hours, seven thousand candles would be needed in order to get the same output of light. He had further calculated that if the candles were placed one on the other they would make a column as high as the Eiffel Tower!

Mr. C. A. MORTON considered that the inverted bowl for the indirect illumination of a living room had a double disadvantage. There was a sharp cut-off produced by the edge of the bowl, and the disadvantage was accentuated if the glass used was a poor transmitter. He thought that the cut-off should be horizontal, and that the filament should be on a horizontal plane. The contrast should not be marked or disturbing.

The author had not sufficiently emphasized the use of opal glassware for general diffusing purposes. With regard to the question of ventilation, in some cases the radiation produced the necessary cooling. He thought that in no case should the brightness exceed 5 candle-power per square inch as a maximum.

Mr. V. O. REES said that he had listened with pleasure and profit to the paper, as he felt sure all present had done. It was clear from what had been said during the discussion that the future of modern domestic lighting was very much bound up with the future of modern house design. It would be rash to prophesy with regard to what might happen, but it looked as if the inside of houses would have to be designed from two points of view, namely, daylight conditions and night-light conditions. The French and German slides indicated that something of the sort was happening. Lighting engineers no doubt had already realized that they must study the effect of the weather on their systems of lighting, and the whole psychology of the matter. He imagined that a house with absolutely uniform illumination would be almost impossible to live in.

Mr. L. C. KALFF remarked that the development of the electric lamp had changed the whole aspect of domestic lighting. There was the question of heat from the source of light. In past ages they had been practically forced to place the light in the centre of the room, and shadows were almost absent. It was now possible to place electric lamps near to surfaces that would suffer from heat; moreover, by design of a filament one could get effects that could not otherwise be obtained.

Mr. C. MCLEAY thought the paper and the slides very interesting. The slides really depicted the higher class of home. More should be done to develop electric lighting for the more modest class of home. He worked in the design office of one of the largest electric firms in the country, and he might mention that he and the majority of his colleagues had gaslight in their houses!

Mr. H. T. YOUNG, in reply, said that he had thoroughly enjoyed the discussion, which had been most interesting. He was pleased to find such a divergence of opinion, as, at this stage in the development of domestic lighting, a great deal of original and creative thought was essential, and, in addition, one of the joys of living was that we did not all think alike. There was not time to answer all the criticisms and questions.

He was delighted to see a number of old friends from the Continent, and to hear their contributions to the discussion. In the early days of the new outlook on lighting, after the Paris Exhibition of 1925, he found it almost impossible to interest seriously our British designers and architects in this country, and he wished to thank Mr. Maisonneuve, from Paris, Mr. Schneider, from Berlin, and Dr. Halbertsma, from Holland, for the assistance they had so generously given him at that time. He was satisfied that the majority of British architects and designers were now fully alive to the possibilities of electric lighting, and he did not mind so much how they used it, so long as they did something which would enable more fully the people of this country to enjoy the "hours of darkness."

Dr. Walsh was looking very much to the future. There was no doubt that the tubular designs of to-day were the forerunners of the more efficient gaseous tubes of the future. Mr. T. P. Bennett's

problems in reflection were, in themselves, worthy of a whole evening's consideration. Mr. Maitland and Mr. Chermayeff were looking possibly too far ahead; he was all for change and variety himself, and there remained many experiments for the courageous to make.

He was himself convinced, after some years of careful study, that surfaces had to be bright to be interesting. Experiments had to be made with the lighting of the room they were now in (the lecture theatre at the Institution of Electrical Engineers), and it was found to be more satisfactory to apply bright additional sections to the large laylight rather than to spread the light all over it. Something was desired that would not cause people to feel sleepy, and, in that room at least, the objective had been achieved, as no one had slept that evening! He had no doubt whatever that rooms without light sources round about sight level became very depressing to the occupant. It needed experience and some skill to judge with reasonable accuracy the method of introducing these lights so as to avoid depression on the one hand and glare on the other.

Mr. Raphael, who preferred the slide showing a mid-Victorian interior, and old-fashioned surroundings, would be interested to know that in the very modern slides shown was a copy of a Hittite chair and Chaldean couch.

Many of the points raised would be answered by a further reference to the paper.

Some Aspects of Street Lighting in the United States

A meeting of the Illuminating Engineering Society was held in the House of the Royal Society of Arts (18, John Street, Adelphi, London, W.C.), at 7 p.m., on Tuesday, April 21st, when the President (Lieut.-Col. Kenelm Edgcumbe) took the chair. An invitation had been extended to all members of the Association of Public Lighting Engineers to attend, and a number of the leading members of the Association were present and took part in the discussion.

After the minutes of the last meeting had been taken as read the names of the following applicants for membership were presented:—

Member:—

Taylor, J. .....Electrical Engineer, 15, Park Road, West Timperley, Cheshire.

Country Member:—

Furness, C. .....Borough Electrical Engineer, Electricity Works, Blackpool.

The names of applicants presented at the last meeting were read again, and they were formally declared members of the Society.*

The PRESIDENT then called upon Mr. W. GRANT MACKENZIE to read his paper entitled "Some Aspects of Street Lighting in the United States," which was illustrated by numerous lantern slides. An interesting discussion followed in which the following took part: Mr. S. B. LANGLANDS, Mr. T. WILKIE, Mr. R. BEVERIDGE, Mr. E. L. OUGHTON, Mr. HAYDN T. HARRISON, Mr. J. COLQUHOUN, Mr. A. CUNNINGTON, Mr. H. H. LONG, and Mr. W. J. JONES.

After Mr. Grant Mackenzie had briefly replied to the discussion, and had been accorded a very cordial vote of thanks for his paper, it was announced that the Annual General Meeting would be held at 6 p.m. on Tuesday, May 19th, in the Lecture Theatre of the E.L.M.A. Lighting Service Bureau (15, Savoy Street, W.C.).

* *The Illuminating Engineer*, April, 1931, p. 87.

The Art of Illumination*

II.—Artificial Lighting as an Art

By John W. T. WALSH, M.A., D.Sc, M.I.E.E.

THE new art of illumination is, as has been said already, the direct result of the great advances which have been made during the last few decades in the production of sources of light of much increased efficiency. Until a few years ago fittings were designed, and lighting systems were planned, so as to obtain the desired illumination on the working plane with the expenditure of the minimum amount of energy. The excellence of a lighting system was, to a very large extent, judged by the ratio of the average illumination produced to the watts of electrical power or the hourly gas consumption per square foot of floor space. Under these conditions it was only natural that the designer of lighting fittings should sacrifice almost every other consideration to that of utility. It is true that, even with this extremely severe handicap, many designs of high artistic merit were produced, but functionalism was inevitably the guiding principle.

To-day matters are altogether different. Some, indeed, may think that the pendulum has swung too far to the opposite side, and that we are in danger of favouring lighting installations in which utility is almost lost in the effort to produce an effect which shall be pleasing to the eye. The design of fittings has been given an entirely new orientation. Beauty of form, either intrinsic or as the result of harmony with its surroundings, is the first requirement of a lighting fitting. In the case of fittings intended for domestic use or for most small lighting schemes, it is frequently necessary to select the most suitable fitting from a range of designs already in existence. For large installations and for such buildings as theatres, hotels, picture galleries and the like, the fittings are often specially designed in each individual case. Sometimes the lighting fitting is not recognizable as such, but forms an integral part of the building in which it is used. This form of lighting system is commonly called "architectural lighting," and in many cases exceedingly fine results have been produced by its means.

It is often considered that in a branch of applied art, such as the design of lighting fittings has now become, the form of material—in this case the lamp bulb or other light source—should itself control the nature of the design to a very large extent. For this reason the tubular form of electric lamp has been adopted in several modern designs. This is, perhaps, a fortunate thing having regard to the almost certain advent of the tubular discharge lamp as a source of light, even for domestic purposes, in the very near future. As far as I am aware, no decorative lighting fittings have yet been produced for use with discharge tubes of this kind. There seems, however, to be no reason why this form of lighting should not now be recognized as an inevitable introduction of the very near future, and I venture to suggest that the production of attractive fittings would in itself help forward this new development in the lighting art. The designer has here a great opportunity before him. What could be more attractive than a slender cylinder of light which can be bent into a vast variety of shapes and the colour of which can be selected with a view to decorative effect and harmony or contrast with the surroundings? It is not difficult to picture a ceiling fitting in which red, blue and yellow tubes are

* Delivered January 27th, 1931. Abstract of the second of a series of three lectures before the Royal Institution. (The first lecture of the series was reported in *The Illuminating Engineer* for April, 1931, pp. 84-86.)

incorporated in such relative lengths as to give a sensibly white light in the room. The tubes themselves might well form a pleasing pattern, possibly blurred by interposing a layer of diffusing glass held underneath them in some specially designed suspension fitting.

The luminous part of most fittings is, naturally, made of some translucent material. Diffusing glass in its many forms, opal, sand-blasted, acid-etched, moulded or prismatic, is naturally by far most popular of the various materials available, and there seems to be no limit to the ingenuity expended in the production of pleasing forms. Some are frankly severe in their lines, while others are ornate and complicated in design.

Glass is, of course, not the only material employed. Vellum is particularly useful for a highly decorative fitting since it can be painted with any kind of design whether it be floral, conventional, oriental or any other that is peculiarly suitable to the locale in which the fitting is to be used. Silk and other fabrics are also used in fittings primarily intended for domestic use or for the small rooms in restaurants and hotels.

It is clearly impossible to refer, even briefly, to all the kinds of lighting fittings available at the present time, but a brief visit to any modern showroom will indicate how great is their variety and how wide is the range open to the designer of a modern lighting system. It is, in fact, so wide as to be bewildering and we cannot, therefore, be surprised if mistakes are sometimes made with results that are as disappointing as they are unexpected. Until the art has been practised for some time it is unreasonable to expect that every effort will result in unqualified success. All that can be done is to promote the study of some of the examples which are generally acknowledged to be successful and to endeavour to deduce from these some guiding principles for use in other cases. That is the most urgent duty of the illuminating engineer of to-day.

For the purposes of this study it is desirable to pick out specimen installations in the many different classes of lighting problems ordinarily met with in practice. The one which naturally occurs first to the mind is domestic lighting. Here it is frequently necessary to adopt some of the fittings such as those which have just been described. The lighting system should be as unobtrusive as possible and the *ars celare artem* should be cultivated by the designer of a lighting system for the home. This does not mean that the positions of the light sources should not be frankly obvious, but that the fittings used to house the lamps themselves should so harmonise with the general furnishings of the room that their removal would spoil the general effect as much as the removal of an important piece of furniture. An interesting modern device is the artificial window. Outside the window itself there is a flat box, whitened internally and containing a number of lamps. The effect is very similar indeed to that of a natural window. Such a device has a great influence on the cheerful appearance of a room, and the contrast between a room so lighted and one in which all the light is supplied by a single fitting suspended from the centre of the ceiling is very marked. Long corridors, which are often dismally lighted by means of a few drop-pendants from the ceiling, can be made almost as cheerful as external balconies by the provision of artificial windows at suitable intervals along one of the side walls. The artificial window has been carried a stage further by setting up a garden scene outside the window so as to produce the illusion of a sun-lit garden. Although such a device may not appeal to many tastes, it cannot be denied that for, say, a ground-floor room in a city block, it is infinitely preferable to the only view naturally obtainable, viz., the internal walls of a court to the bottom of which the daylight struggles in a despairing fashion, especially on a dull day in mid-winter.

In passing we may, perhaps, notice the luminous ornament. This cannot, of course, be considered as a lighting fitting in the proper sense of the term, but it does legitimately come within the scope of our subject as in it light is employed for decorative purposes. A restrained use of colour is of considerable value in the production of a pleasing ornament. This colour may, of course, be incorporated in the ornament itself, or the ornament may be colourless and the lamp used in it may be of whatever colour happens to suit the situation in which the ornament is to be placed.

Office lighting can, of course, be carried out in a very similar way to ordinary domestic lighting. In many cases artificial roof windows have been used very successfully. It may be mentioned here that most people find it trying to work for any length of time in a room lit entirely by a roof window, whether the source of light be daylight or some kind of artificial illuminant. It is, therefore, generally preferable to use side windows, either alone or in combination with a roof window.

Public buildings, such as large municipal halls, permanent exhibition buildings and the like, are frequently woeful examples of splendid architectural design which is completely wasted at night owing to the totally inadequate and unsuitable lighting provided. Recent years have, however, seen a tendency to improvement in this respect, and some of the more recently erected buildings of this class have lighting systems which satisfactorily supplement the architecture and make the buildings a treat to the eye by night as well as by day.

The lighting of churches and cathedrals is a matter over which the illuminating engineer cannot expend too much thought. Generally speaking, these buildings were designed without any regard whatever to the use of artificial lighting. It is, therefore, extremely easy to spoil the whole appearance of the architecture in the daytime by the intrusion of conspicuous and ugly fittings, and at night owing to the production of strange and unnatural shadows by light coming from sources placed in unsuitable positions. Generally speaking, it has been found best to place the light sources at a considerable height above the ground and, in fact, the flood-lighting of nave and choir, either from the roof itself or from the spring of each arch is a method which has often been followed with great success.

The lighting of picture galleries and art exhibitions is a particularly difficult problem, and it is one which is just now very much in the minds of those responsible for the care of our national art collections. At the present time most of the largest of these are closed at dusk, but it is expected that fairly soon the provision of artificial lighting will enable the National Galleries, at any rate, to remain open after dark. There are two problems, apart from the provision of an adequate and moderately even illumination, which have to be considered. The first is the colour of the light. It is frequently contended that as most pictures are painted by daylight, they should be viewed only by light of the same colour and, therefore, the artificial lighting in a picture gallery should be fully corrected to daylight colour. On the other hand, actual experience seems to indicate that only a partial correction may be necessary and this is, of course, much more easy to obtain. It cannot be said, however, that it has yet been possible to formulate any very definite conclusions on this matter. Another difficulty which arises

in many picture galleries, and certainly in the large galleries in London, is due to the glazing which has to be used to protect the pictures from the dust and dirt of the London air. Unless great care is exercised in the placing of the light sources, these will be reflected in the glass covering the pictures and in certain positions the spectator may be able to see nothing but a brilliant image of the lamp and its fitting. Although it might be difficult to apply it to very large pictures, the "K-ray" system of illumination gives a very pleasant effect and it might well be used for individual pictures hung in the rooms of private houses.

Shop lighting is really divisible into two sections. There is first the lighting of the interior of the shop, where the goods are sold, and then there is the lighting of the window used solely for display purposes. The interior lighting does not generally present any peculiar problems. A high degree of illumination is desirable and the fittings used should, of course, be pleasing in appearance. In cases where colour matching is of importance, provision should be made for goods to be compared by some form of artificial daylight in which an accurate imitation of natural daylight is produced. The mistake is sometimes made of providing for this purpose an artificial-daylight unit suspended above a counter which is exposed to the general lighting of the shop. Such a method is perfectly useless. Artificial daylight is of no use for colour matching unless all other lights are completely excluded from the article under examination. The observer's eye, too, must be carefully protected from receiving even the slightest trace of uncorrected artificial light. The best method is, in fact, to have a large light-tight cubicle, furnished with artificial daylight, into which the goods to be matched can be taken as may be desired.

Shop-window lighting is characterized by two things in particular, viz., the use of very high intensities and the employment of coloured light. With regard to the former matter, intensities as high as 100 foot-candles have been used. When it is remembered that for ordinary purposes 10 to 15 foot-candles is considered ample, it will readily be appreciated that 100 foot-candles gives a brilliant effect and one that achieves the purpose for which it is intended, i.e., to attract the passer-by and compel his attention to the objects displayed. The use of coloured light is due to the same desire, viz., that of attracting attention by the presentation of some unusually pleasing or exceptionally bizarre spectacle. Many people would prefer the pleasing to the bizarre and for this reason the use of highly saturated colours is generally to be discouraged. A window entirely flooded with a deep blue light but having in it one object on which is cast a red beam from a spotlight may be striking in its effect but it cannot be called pleasing. The use of automatic dimmers and switches for producing continuous changes in the colour scheme of a shop window is a perfectly satisfactory method of attracting attention to a display if each of the colour schemes is so designed as to be pleasing in itself.

Of all the lighting problems which have attracted attention within the last few years it is probably safe to say that the illumination of places of public entertainment has been the most frequently to the fore. In particular, each new large theatre for the presentation of moving pictures has attempted to outdo its predecessors by the installation of a more elaborate or a more artistic system of lighting.

Among the theatres showing stage plays, the Savoy was the first to adopt modern lighting on an elaborate scale. The auditorium of this theatre will well repay a visit from anyone interested in the art of lighting by artificial light.

Stage lighting is, of necessity, an art in itself. It has been in existence in some form or another for many years, but it is only comparatively recently that modern lighting facilities have made it possible to produce the wonderful effects which are now obtainable in some theatres with really up-to-date equipment.

Perhaps the most notable recent advance in the art of stage setting is the introduction of the artificial horizon. This consists of a half-dome, or a semi-cylinder, of some highly reflecting white material on which can be projected a flood of light from the bank of special projectors provided for the purpose. By means of a very elaborate piece of apparatus used in some theatres, it is possible to project on to the artificial horizon cloud pictures of any desired type moving across the scene at any appropriate speed.

In some cases landscape scenes are projected on to the artificial horizon by means of a special projection apparatus. Special effects, such as the appearance of a rainbow, can be imitated with great success by the use of suitable optical apparatus and the artificial horizon.

In the field of exterior lighting there are two principal purposes for which light is used as a method of appeal to the eye. The first of these purposes is advertisement, and sign lighting is now a very important branch of illuminating engineering. Probably everyone is familiar with the various types of light signs in common use to-day, and probably most people will agree that while some few are pleasing to look at, the majority are hideous in the extreme and are examples of illuminating engineering activity in its worst form. The introduction of the discharge tube in its various colours has done much to improve matters but there is still a great deal of educational work to be done among the designers and users of light signs before night advertising can be brought up to the level of the many really fine posters exhibited by day at the present time. We owe a great debt of gratitude to some of the larger commercial houses for their encouragement of poster art at the beginning of the present century and what is needed now is similar public-spirited enterprise on the part of some of the large users of illuminated signs.

Floodlighting is the other form of external lighting which is not intended solely for utilitarian purposes. In the United States of America many large buildings, some privately owned and some belonging to public authorities, have been floodlighted for a considerable time past. The outstanding example is, of course, the dome of the Capitol at Washington. Another example, also at Washington, but of quite a different character, is the Abraham Lincoln memorial. Floodlighting in this country is somewhat hampered by by-laws concerning the distance in front of the building face at which it is permissible to place the projectors, but when the architect has had floodlighting in mind when designing his building front, some very effective results have been achieved. A very successful example familiar to all Londoners is the new headquarters of the Underground Railways at St. James's Park.

Artificial lighting is now extensively used for carrying on various forms of outdoor amusement after dark. Greyhound racing tracks, football and hockey grounds, lawn-tennis courts, baseball grounds and bathing pools are now frequently lighted so that they can be used at night. In most cases, however, the lighting is strictly utilitarian in design. There is one rather novel example of decorative lighting, however, which was first tried out in America last winter. At Lake Placid, in the

heart of the Adirondacks, there is a very popular skating club and it was desired to celebrate the 25th year of the club's existence by providing some special lighting effects which would be both novel and striking. After experiments with artificial ice during the previous summer, two kinds of display were arranged. In the first, a pile of some 20 tons of broken ice, 20 ft. in diameter at the base and 10 ft. high, was lighted internally by about 60 or 70 lamps of various colours. The lamps were held in position in the pile by means of a skeleton framework but when the pile was completed nothing could be seen but the light shining through the ice. Flashers were used to produce a constantly varying colour scheme and the great luminous pile could be seen right across the lake from the village of Lake Placid.

The other novel form of ice lighting consisted of a great star formed by some 170 lamps frozen directly into the ice of the skating rink. This star was laid out on the ground before the rink was flooded and then 10-watt yellow-bulb lamps were screwed into the sockets and further 25-watt red and green lamps were used to form the club's initials in the centre of the star. The rink was then flooded and froze rapidly and the effect, when the lamps were lighted, was most attractive.

The lighting of exhibitions such as the British Empire Exhibition at Wembley is generally considered to be an art in itself, although floodlighting and outlining by discharge tubes are naturally methods which are extensively applied to the individual buildings of an exhibition of this kind. Coloured floodlighting is frequently used and changing colours for the façade of some particular building can be arranged fairly easily since there are no restrictions on the number or position of the projectors employed. Luminous fountains and cascades, illuminated steam jets and other fanciful devices find their proper place in exhibition lighting. The first exhibition in which modern lighting devices were really used extensively was the Panama-Pacific exhibition held in San Francisco in the year 1915. Some very beautiful and striking effects were obtained at the Barcelona Exhibition last year.

In conclusion, I should like to emphasize that it has only been possible in this lecture to pick out, more or less haphazard, a few examples in the various branches of artificial lighting. Many installations of wonderful beauty and attractiveness have not been mentioned. Almost every day now sees some fresh triumph of the illuminating engineer who is treating his subject as an art and not as a matter of lumens, watts and therms per hour. From the little that has been said you will have gathered that interest in this new art is by no means confined to this country. France was, perhaps, the pioneer. Certainly Germany and the United States of America are well in the running with this country and with France. Each country, of course, tends to express its national standard of æsthetic taste in the new art. It is, perhaps, fortunate that just at this stage in the development of the lighting art, an opportunity should have occurred for illuminating engineers from all over the world to meet in conference for the discussion of lighting problems and the interchange of ideas and comparison of methods. The fact that the eighth meeting of the International Commission on Illumination is to be held in this country next September has led to the calling of a World Congress on Illumination. The plans for this congress are now well advanced and it is expected that it will be attended by no fewer than 300 illuminating engineers from overseas. It is not possible at this moment to say much about the spectacular displays of lighting which have been planned both in London and in the provinces on the occasion of this congress, but quite apart from these, there can be no doubt that the gathering of such a large number of the lighting experts from all civilized countries cannot fail to have a marked effect on the progress of illuminating engineering. While much of the time will doubtless be devoted to the strictly technical and engineering side of the subject, the side to which we have been devoting our attention this afternoon will not be neglected. The International Illumination Congress of 1931 will, I am sure, give a great impetus to the art of illumination and a great encouragement to those who have so much faith in the possibilities of this new branch of applied art.

Literature on Lighting

(Abstracts of recent articles on Illumination and Photometry in the Technical Press)

(*Continued from page* 88, *April*, 1931)

In this number we continue the publication of abstracts of articles of interest. Abstracts are classified under the following headings: I, Radiation and General Physics; II, Photometry; III, Sources of Light; IV, Lighting Equipment; V, Applications of Light; VI, Miscellaneous. A panel of abstractors has been formed, and the following, whose initials appear under the items for which they were responsible, have already assisted in the compilation of abstracts: Miss E. S. Barclay Smith, Mr. S. S. Beggs, Mr. F. J. C. Brooks, Mr. H. Buckley, Mr. H. M. Cotteril, Mr. I. S. Dow, Dr. S. English, Dr. T. H. Harrison, Mr. C. A. Morton, Mr. G. S. Robinson, Mr W. C. M. Whittle and Mr. G. H. Wilson. This new departure seems to have already proved helpful to readers and to members of the Society. Abstracts cover the month preceding the date of publication. When desired by readers we will gladly endeavour to obtain copies of journals containing any articles abstracted and will supply them at cost.—ED.

I.—RADIATION AND GENERAL PHYSICS.

53. Reflection Factors. G. Peri.
Elettrotecnica, xviii, *p.* 153, 1931.

Gives a general account of diffuse reflection and the correlation of the various photometric magnitudes involved in such reflection. H. B.

54. Colour Vision. R. A. Houston.
Phil. Mag., 11, *p.* 552, 1931.

A theoretical discussion, based largely on photochemical ideas, on the part played by rods, cones, etc., in colour-vision. There is also a theoretical note on the relative visibility of the different colours of the spectrum. H. B.

55. Energy Measurements in the Visible and Ultra-Violet. F. Benford and R. F. Howe.
Am. Illum. Eng. Soc. Trans., 26, *pp.* 292-303, 1931.

The three common ways of making energy analyses in the visible and ultra-violet are the photographic, the filter and the monochromator method. The inherent limitations of all three are discussed with reference to measurements of sunlight and some of the common source of light and ultra-violet radiation. As a preliminary to the discussion of measurements a short outline is given of physiological effect within the wavelength limits 2,000A to 4,000A. G. H.W.

56. Calculation of Average Illumination in the Presence of Uniformly Bright Diffusing Surfaces. V. Genkin.

R.G.E., Vol. 29, No. 10, pp. 369-375, March 7th, 1931.

In this article the author shows that in the case which is of practical interest, viz., a room in the shape of a parallelepiped, the problem of determining the average illumination becomes that of determining the greatest geometrical distance. In order to facilitate the numerical calculation, the values of the coefficients occurring in the given formula are given in the form of a curve. Mathematical.

W. C. M. W.

II.—PHOTOMETRY.

57. On the Theory of the Ulbricht Sphere. A. Buchbinder.

Zeits. f. techn. Physic., 12, *p.* 164, *March*, 1931.

The fundamental properties of the Ulbricht sphere are derived anew. A general equation is advanced for any surface and it is shown that only the sphere possesses these fundamental properties.

G. H.W.

58. On the Reflection and Transmission of Light: Their Investigation and a new Instrument for Measuring Reflection and Transmission. R. G. Weigel and W. Ott.

Zeit. fur. Inst., 51, *p.* 1 *and p.* 61, 1931.

A lengthy paper dealing with: 1. The importance of reflecting and transmitting materials in illuminating engineering. 2. The properties of reflected and transmitted light and the problems of research. 3. A historical review of former work. 4. Description of the new instrument. 5. Its performance. The instrument may be used for the determination of reflection and transmission properly in different directions and also in conjunction with an integrating sphere for the determination of total reflection and transmission.

H. B.

59. A new Slide-rule for Illumination and Size of Conductor Calculations. Edwin Besser.

Light, *p.* 157, *March 15th*, 1931.

For the purpose of constructing this slide-rule, the product of the horizontal luminous intensity (I) and the area illuminated (A) is taken as equal to the product of the number of lamps (N) the lumen output of each (L) and the coefficient of illumination (η) i.e., $IA = NL\eta$. The rule has two sliders in one groove, the first fixed face is marked logarithmetically in areas; the succeeding sliding edges are marked (I) luminous intensities, (II) number of lamps, (III) lumens per lamp, (IV) an arrow to be brought to the coefficient of utilization figure which is marked on the second fixed face. The reverse face is used for calculations concerning the sizes of conductors.

S. E.

60. On the Limitations of Photometry. André Blondel.

Comtes Rendus, 192, *pp.* 782-786. *March 30th*, 1931.

The author distinguishes the related subjects of photometry, physiological optics, and experimental psychology, and shows the different points of view from which the properties of a projector are regarded in each case. He considers that this distinction should be made more clear, and suggests that in dealing with an effective point source (e.g., a lighthouse or a motor-car headlight at a considerable distance) the intensity of the source should be specified by means of its brilliancy in terms of candles at 100 metres, instead of by means of the illumination which it produces, stated in terms of lux.

S. S. B.

III.—SOURCES OF LIGHT.

61. Low Voltage Tube Lighting. Anon.

El. World, 97, *p.* 234, *February*, 1931.

Gives data and descriptions of use of low voltage tubes for general interior lighting. It is stated that less than 20 per cent. of the power is required to produce blue or green light as compared with filtered incandescent light; 33 per cent. of the power for red and 50 per cent. for white. The life of the lamps is given as 3,000 hours. At present there is a time lag of 7 secs. on starting lamps.

W. C. M.W.

62. Light Intensity of the Mercury Lamp. Anon.

El. Rev., 108, *p.* 597, *April 3rd.*

This article summarizes the chief characteristics of the mercury-vapour lamp. With a constant terminal voltage the light emitted varies as the current. In a special D.C. lamp made of fused quartz the relation between the current I, the light intensity G and the potential difference V was given by $G = kI(V-V_0)$ k and V_0 being constants. It was found that similar law holds for an A.C. lamp.

G. S. R.

63. New Gas Discharge Tubes. M. Pirani.

E. u. M. Licht, 8, *pp.* 1-3, *March*, 1931.

The principles underlying radiation from discharge tubes and the form of discharge are discussed. Practical applications are mentioned.

G. H.W.

IV.—LIGHTING EQUIPMENT.

64. Neon Signs.

Elect., 106, *p.* 443, *March 20th*, 1931.

A short analysis of the neon sign situation in Canada, as given by S. W. Murdoch, of the Hydro-electric Power Commission, of Ontario, in the February issue of *Electrical News and Engineering*. Mention is made of the various colours possible with various gases and tinted tubes. Experiments are being conducted to produce a white light, which, if successful, may make a radical change in interior lighting. The power factor problem arising out of the use of such illuminants is discussed. Reference is made to a neon sign in Montreal containing over a mile of tubing and believed to be the largest in the world.

C. A. M.

V.—APPLICATIONS OF LIGHT.

65. Foot-candle Effectiveness: A Measure for Illumination. M. Luckeish.

El. World, Vol. 97, *No.* 12, *pp.* 553-4, *March* 21, 1931.

The author suggests that for general purposes 10 foot-candles is a desirable level. In the case of printing on coarse paper, e.g., a telephone directory, 30 foot-candles may be desirable. Gives comparisons for threshold visibility between a telephone directory and a book of fine typography.

W. C. M. W.

66. Visual Performance under Daylight, Incandescent, Mercury Vapour and their Mixtures. K. Y. Tang.

Am. Illum. Eng. Soc. Trans., 26, *pp.* 258-269, *March*, 1931.

This investigation consisted of two entirely different tests, undertaken with the same general object, namely, that of comparing the rapidity with which a detail of a test object could be perceived, using, at the same levels, the usual light sources, alone and in combination. The primary source of light for both tests were natural daylight, incandescent electric light from tungsten filament bulbs, and mercury vapour or light. The illumination levels studied were 5, 10 and 20 foot-candles on the test object. Each kind of light was used separately at all three intensities, and combinations of two and three kinds in equal amounts were also used at all three levels.

G. H. W.

67. Local Lighting in Industry. W. Imrie-Smith.

El. Times, 79, *pp.* 661-2, *April* 9, 1931.

The requirements for local lighting in industry are classified as follows: 1. Use of extra high intensity: Necessary for small accurate work such as watchmaking and polishing. 2. Points of work inaccessible to general lighting: For repair work in difficult positions and in certain types of deep boring work local lighting is necessary to overcome shadows. 3. Lighting requires special features: In such cases as grading coloured goods or overcoming shadows or showing work up in relief, special fittings are required.

G. S. R.

68. Electric Lighting of Elliptical Surfaces. H. Pécheux.

R.G.E., 29, *p.* 297, *February*, 1931.

Gives a method for determining the least necessary luminous intensity to obtain a given intensity of illumination on an elliptical surface. Deduces a number of formulæ applicable to different geometrical cases. Considers both bare lamps and lighting fittings. Mathematical.

W. C. M. W.

69. Daylighting in the Home. W. C. Randall and A. J. Martin.

Am. Illum. Eng. Soc. Trans., 26, *pp.* 275-291, 1931.

Improvements in the daylighting of places of residence is possible by the proper treatment of the window openings. Data are presented on the effects of different types of curtains, shades, drapes and screens with respect to their influence on the interior daylighting of full-sized rooms, and conclusions drawn from the observations. Details of the apparatus used and the manner of testing are presented in part II. of the paper. G. H. W.

70. Stained Glass Window Lighting. Anon.

El. Rev., 108, *p.* 511, *April* 3, 1931.

Gives photographs of the stained-glass window of the Grand Hall, Middle Temple, which is externally floodlit by two projectors to give a night view from inside. G. S. R.

71. An Illumination Scheme at Drages. Anon.

El. Rev., 108, *p.* 625, *April* 10, 1931.

A half-page article gives photographs of the unusual lighting scheme adopted in this store. The main lighting is from raindrop glass troughs suspended from the ceiling, cornice lighting; there is also supplementary decorative lighting.

G. S. R.

72. Aviation Illumination. F. Born.

Zeits. f. techn. Physic., *p.* 167, *March*, 1931.

The technical arrangements for night air transport as an economic complement of day air transport have been developed in the past year to a high degree of completeness. The pressing need of standardization of heating and lighting euqipment makes an international pooling of work desirable.

G. H. W.

73. Street Lighting in History. Anon.

El. Rev., 108, *p.* 598, *April* 3, 1931.

In ancient times Rome and Antioch and other big cities had street lights. Paris was one of the first mediæval cities to introduce street lighting, and in 1558 probably about 3,000 torches were in use for this purpose. London first had lights in 1417, and about 1800 came gaslighting. The first electric candle appeared in 1878. G. S. R.

74. A Sign-Writing Searchlight. Anon.

Elect., 106, *p.* 567, *April* 10, 1931.

A photograph is given of a sign-writing searchlight recently demonstrated in Berlin. It is claimed that it is capable of projecting letters over 12,000 ft. high to clouds at an altitude of 6,000 ft.

C. A. M.

75. Effect of Surroundings. F. K. Moss.

Light, *p.* 37, *March*, 1931.

The article discusses the effect upon visual efficiency of less bright surroundings that occur during the employment of supplementary lighting to augment general lighting. C. A. M.

VI.—MISCELLANEOUS.

76. Colour Measurement. F. Ellrodt.

Licht u. Lampe, 20, *p.* 131, *No.* 8, 1931.

A general discussion of light measurements based on the Young-Helmholtz colour theory. Eye sensitivity is taken into account and the use of filters is considered. E. S. B.-S.

POPULAR & TRADE SECTION

COMPRISING

Installation Topics—Hygiene and Safety—Data for Contractors—Hints to Consumers

(The matter in this section does not form part of the official Transactions of the Illuminating Engineering Society and is based on outside contributions.)

An Historic Piece of Floodlighting

In our last number* we referred to the special floodlighting being prepared in connection with the International Illumination Congress, which takes place in this country in September next. Preliminary trials have already been undertaken, and of these the floodlighting of Big Ben clock tower, which stands as a sentinel guarding the Mother of Parliaments, is surely one of the most interesting.

This special problem, which has been entrusted jointly to Messrs. Siemens, of Woolwich, and Messrs. Holophane Ltd., of London, is a somewhat intricate one, bearing in mind the unusual height, the distance and angle of throw, and the very dark texture of much of the surface of the tower. The trial projectors were mounted near the river embankment wall, which is 170 ft. distant from the base of the tower. Mr. A. W. Hattersley, the chief engineer of the Houses of Parliament, had erected on the Speaker's Green a suitable staging, on which 12 Holophane-Siemens large-range double-parabolic projectors, each equipped with a 1,000-watt lamp, were mounted. In order to furnish a distinctive colour-contrast the ten 100-watt lamps, which normally light the clock face from behind, were replaced by 150-watt amber-sprayed lamps.

One special difficulty arises from the fact that immediately above the clock-face section the belfry is set back, so that the projector-beams cast deep shadows on the collonade arches. This has been obviated by the use of local lighting by means of concentrating silvered reflectors, equipped with 100-watt lamps and pointing upwards.

Inspection of the tower from the opposite side of the river near St. Thomas's Hospital gave reassuring results. The appearance thus seen was quite impressive, even though the illumination provided was only one-third of that which will ultimately be provided on the occasion of the International Illumination Congress, when three sides of the tower will be floodlighted. We are indebted to Messrs. Holophane Ltd. for the accompanying illustration.

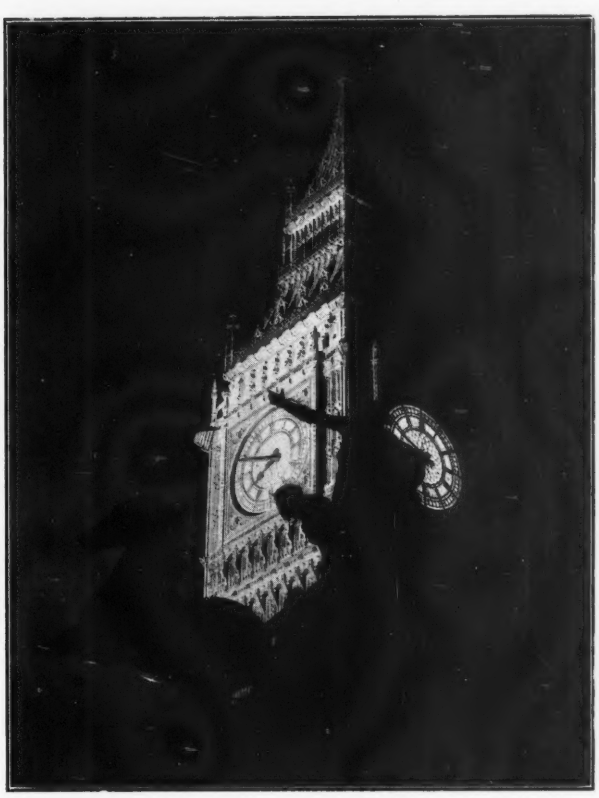


FIG. 1.—Showing the appearance of Big Ben Clock Tower floodlighted.

Holophane Municipal Conference

A conference attended by municipal engineers and representatives of electric supply undertakings was arranged by Holophane Ltd. on April 15th at the premises of the company in Elverton Street, Westminster. After Mr. H. Hepworth Thompson, the managing director, had said a few words of welcome a brief address was delivered by Mr. J. S. Dow, who referred to the various aspects of lighting problems of special interest from the municipal standpoint, and pointed out how lighting by modern methods furnished a most valuable load to electrical supply undertakings. In conclusion, he conveyed a welcome to visitors to join the Illuminating Engineering Society, and drew their attention to the forthcoming International Congress.

Mr. W. T. Dean then dealt with sales problems and Dr. S. English gave an illustrated address on The Manufacture of Holophane Glass. In the afternoon, after an interval for luncheon, further addresses were given by Mr. E. Stroud (Holophane Developments), Mr. R. Gillespie Williams (Colour Lighting Demonstration) and Mr. L. M. Tye (Practical Applications of Holophane). Tea, discussion and the inspection of the laboratory (Practical Applications of Holophane). The day was concluded by dinner at the Criterion Restaurant.

We have no doubt that Holophane Ltd. will reap the reward of their enterprise in arranging these periodical conferences which are designed to reach in turn different professional and trade circles. But apart from their business aspects such gatherings undoubtedly do a great deal to foster interest in illumination generally.

* *The Illuminating Engineer*, April, 1931, p. 93.

The Lighting of the Capitol Cinema, Didsbury

THE lighting of the Capitol Cinema at Didsbury, Manchester, embodies the new ideas and methods characteristic of this field of illumination. The design of the building itself, which includes a free car park for 500 cars and an auditorium seating 2,000 people, is itself interesting, and the decoration and lighting have been designed on original lines. The colour-lighting installation, which was planned even before the internal decorations had been settled, is considered to be one of the most advanced schemes yet devised by Holophane Ltd., to whom we are indebted for the adjacent illustrations.

The main lighting of the auditorium is from three-colour equipment concealed in a large cornice on either side of the hall. But there are three separate runs of lighting equipment concealed in the cornices—(1) for the illumination of ceiling, alone furnishing sufficient light for the whole hall; (2) directing light in concentrated beams for the lighting of the walls; and (3) illuminating the interiors of the cornices themselves. In each case the colour of the lighting may be varied within wide limits so that a multitude of colour-combinations is possible.

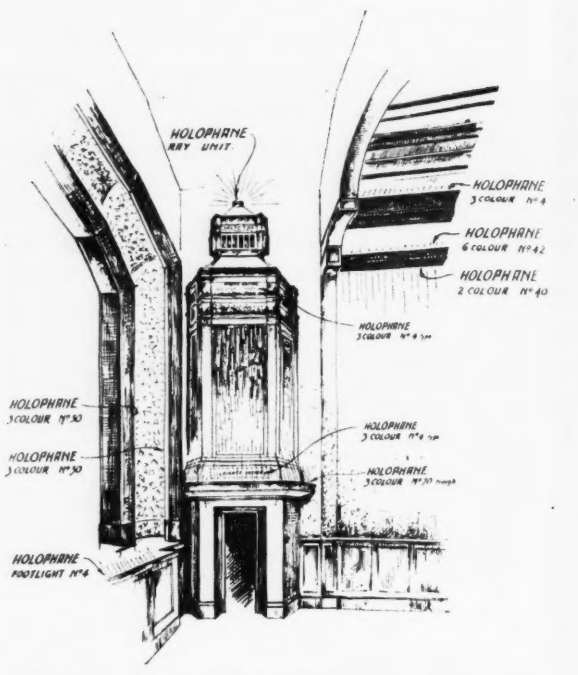


FIG. 1.—Proscenium End of Auditorium at Capitol Cinema, Didsbury.

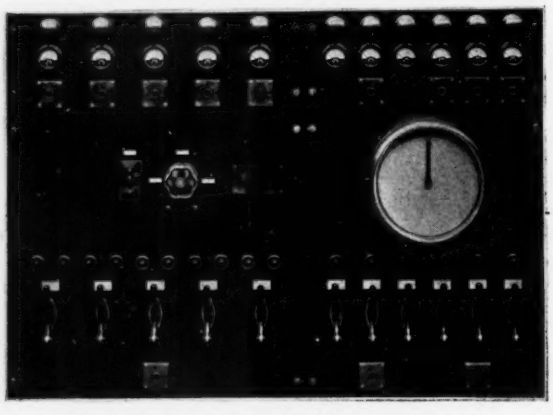


FIG. 2.—The Control Panel of the Holophane Auto-Control for the Auditorium Lighting at the Capitol Cinema, Didsbury. One twist of the small centre hand dial only will send this most complicated colour-lighting installation through thousands of colour symphonies.

The ceiling has been cleverly shaped with a series of angled surfaces, so as to catch the light, and it is thus broken up into lines in varying tones of the same colour. The proscenium opening is surrounded by a proscenium cove with three-colour units concealed on both sides, and this, too, enables distinctive effects to be obtained. Between the proscenium coves and the auditorium cornices are two "pagoda grilles," which serve mainly to enable the organ music to enter. They are covered by rumpled white gauze curtains, which are again illuminated by three-colour equipment. A feature of the entire scheme is the way in which decoration and lighting effects are combined. Thus the main walls of the auditorium are treated in designs of stippled surfaces of varying depth, which again offers possibilities of varied combinations of light received respectively from the ceiling and cornices.

Needless to say, these numerous colour-changes are operated on a predetermined plan which was studied in detail beforehand. Even the colours of material used for the seating have been selected in order to fit in with the general effect. An operating box of 33 ft. by 24 ft. is provided, and is considered to be one of the finest in the country. With the new Holophane automatic controller the series of effects is set in motion merely by a quarter-twist of one hand-wheel. So varied and elaborate are the colour-changes (which can, however, be determined by "pre-setting" the control in any desired manner) that they could never be effected by hand alone. It is calculated that 5,044 different combinations of colour-lighting can be obtained without effecting any change in the controlling machinery.

The stage lighting also presents interesting features, and it may be mentioned that the whole of the draperies and curtains, as well as the lighting equipment and stage switchboard, were provided by Holophane Ltd.

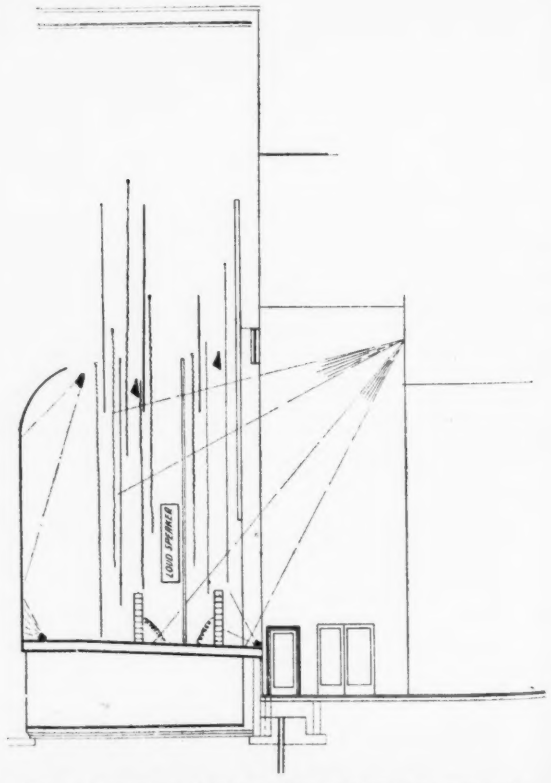


FIG. 3.—Layout of Holophane Stage-lighting Equipment and Draperies, Capitol Cinema, Didsbury.

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Tungsram's New Staff House and Sports Pavilion

An Interesting Example of Modern Lighting

By A. H. BODY

THE present-day trend towards better lighting is well illustrated on the Continent and especially so in those towns where the headquarters of the large lamp companies are situated. Such companies have given a considerable local impetus to this move-

FIG. 1.—Budapest by Night.

ment by demonstrating the possibilities of lighting "for effect," such as floodlighting and interior-decorative lighting as well as for purely utilitarian purposes where efficiency is the chief consideration. Societies, circles and bureaux for the propagation of the movement towards better lighting are now common. The result of their influence is seen in many of the newer buildings which have installed special schemes of lighting in place of other more expensive forms of decoration.

A city which well illustrates this tendency is Budapest, near which is situated one of the main factories of the Tungsram organization. Here one finds the most up-to-date lighting methods applied. To the traveller arriving at night by boat the scene which unfolds itself is one of the most beautiful it is possible to imagine—important buildings are floodlighted and the whole presents a scene which is most unreal. This city is also not backward in regard to interior decorative lighting. In the majority of new buildings special attention has been paid to this point, whilst in many of those already

FIG. 2.—Tungsram Staff House.

existing the entire lighting systems have been remodelled.

This progress towards continually better illumination naturally receives the strong support of the Tungsram Company which has recently built a large staff house and sports pavilion near their factory at Ujpest. The lighting installation serves as a practical demonstration of modern equipment both for rooms devoted to social intercourse and indoor sports. This staff house is intended primarily to furnish employees with a place in which they can spend their leisure hours and it has accordingly been fitted out in such a manner as to cater for the most varied tastes. In addition to ordinary recreation rooms there is a large theatre which is convertible into a dining hall, a full-size covered tennis court also capable of serving as a gymnasium or dance hall, and numerous other rooms, including dressing rooms, bathrooms, cloakrooms, etc.

The lighting of this building, both indoor and out, is of the most modern type and is one of its most striking features. The exterior is lighted by means of 30 diffusing globes each containing a 60-watt lamp and mounted in pairs on fifteen metal standards. These are equally spaced along two sides of the building and serve both to furnish adequate illumination in the vicinity and also to illuminate the building, the surface of which is fairly light in colour and consequently shows up well. On going into the entrance hall one notices a centre ceiling fitting of

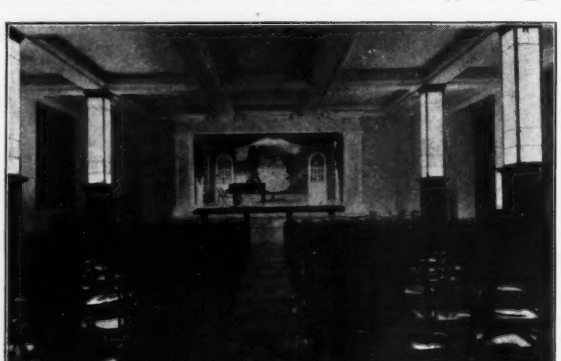
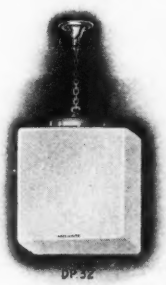
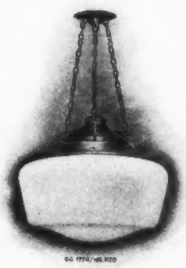
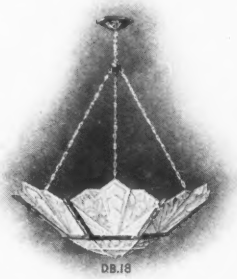


FIG. 3.—Theatre and Dining-Hall.

opal glass which contains one 100-watt, five 60-watt and ten 40-watt lamps, whilst, in addition, there are several hanging units and an indirect cornice for decorative effect, making a total load of 1.8 kilowatts.

Situated on the ground floor is the theatre which can also be converted into a dining-hall for the employees. An all-electric kitchen which adjoins this hall supplies food, having one of the most up-to-date cooking plants installed as well as serving as a model for "good lighting in the kitchen." The theatre itself has no natural lighting at all and depends for its illumination exclusively on two systems of artificial light—indirect and direct; the former has been arranged by means of troughs which are carried in the beams crossing the ceiling (although in the accompanying picture this system is not in use it is easy to see how it is arranged and to visualize it in operation). The actual lamps used are of the 25-watt tubular double-ended type and there are 43 to every section across the ceiling. The other system is by means of illuminated pillars which are fitted with diffusing opal glass panels and behind which are placed 32 25-watt double-ended tubular lamps and seven ordinary 25-watt lamps. With both systems in use simultaneously the load is about 30.5 kilowatts. The effect is particularly good, the main



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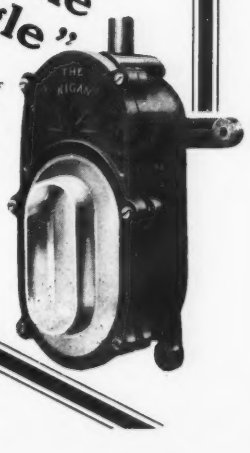

features being an almost entire absence of any shadows and an even distribution of light over the whole area. The stage is situated at the far end of this hall and is lighted by means of lamps arranged on overhead battens on a three-colour circuit and

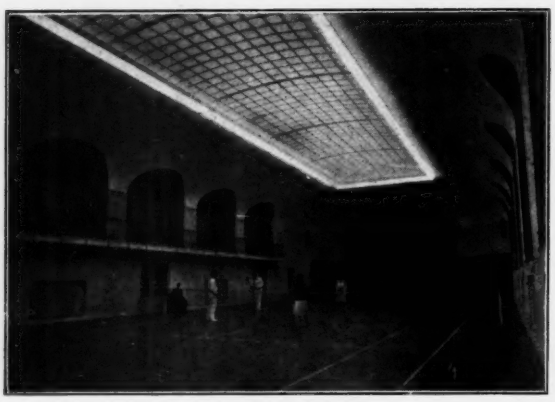

FIG. 4.—The Tennis Court and Gymnasium.

also by footlights similarly arranged. The total number of lamps used in this installation is 137 of 60-watt each, there being 99 for overhead lighting and the remainder for footlights. In addition to these there is a diffusing globe containing one 100-watt lamp which is used for general purposes. The total load exceeds 8 kilowatts.

As may well be imagined one of the most important parts of the buildings is the tennis court and gymnasium, which is situated on the upper floor and is approximately 112 ft. long and 47 ft. wide. A full-size tennis court is marked out on the floor and a game can be enjoyed here under ideal conditions however inclement the weather. In addition, there are all manner of appliances such as are found in most gymnasiums, and on occasions dances are even held here, there being a special alcove with a low platform to accommodate the orchestra. The main lighting of this room is provided by an artificial skylight made of diffusing-glass panels, behind which are 15 reflectors each containing a 1,000-watt lamp. Around this skylight are arranged 300 small glass cubes each containing a 25-watt lamp. Both systems are controlled by means of automatic switches concealed behind the door in one corner of the hall. The skylight and the outside row of glass cubes can be used either together or separately and the latter is so arranged that it is possible to light every third

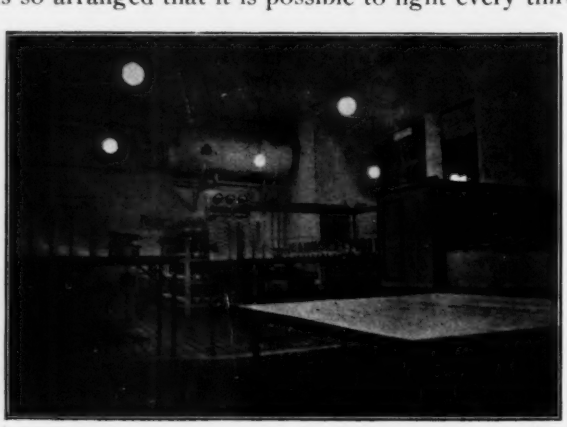

FIG. 5.—The "All-Electric" Kitchen.

cube or to light two leaving every third out. The effect obtained with either or both systems in operation is one of shadowless lighting and the total load is 22.5 kilowatts although the amount used is not always as great as this, some recreations requiring considerably less light than others.

The other sections of this building are all equally well lighted and the picture of a cloakroom illustrates extremely well the possibilities of lighting which is wholly indirect.

Heating and ventilating have also received special attention, radiators having been installed in every room and in many cases sunk into the wall in order to give a better appearance, whilst a special system of ventilation is used in order to prevent the "stuffy" effect which is so often associated with central heating.

In all respects the Tungsram staff house is most modern and up-to-date and has been received with great enthusiasm by the employees, who find it an excellent centre for all their social activities.

FIG. 6.—Cloak Room, effectively illuminated by indirect light.

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